THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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(J. A. BERLY'S).

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ABOUT GAS.

OUR respected contemporaries devoted to the service of the gas supply industry are, we believe, assiduous readers of our pages, judging by the keenness with which they pounce upon any item out of which they think they can make capital, and the zeal with which they repel any statement which bears a signification adverse to their interests. We may therefore be allowed to make a few comments upon the contents of their columns, which we feel sure will not exaggerate the arguments against gas lighting.

In the *Gas World* for April 1st *(absit omen)* a paper on "Some Modern Aspects of Gas," by Mr. W. Upton, a former president of the London and Southern District Junior Gas Association, was abstracted, in the course of which the author uttered some home truths about gas. After referring to the varying calorific values of the gases supplied in London, which, he considered, would eventually lead to the imposition of a calorific standard, Mr. Upton, putting this aside, said that what did form a serious ground of complaint was the varying pressure given throughout the day. A gas fire that refused to incandesce in the early morning for want of pressure was not a good advertisement for gas, and the fact that it could "cheerfully roar" in the evening did not counterbalance its earlier errors. We are aware, of course, that heating by gas is claimed to be the ideal system; it is sad to learn, therefore, on such high authority, that in practice it falls so far short of perfection. But this is nothing to what follows.

We have been told that gas is pursuing a triumphal progress through our towns; yet Mr. Upton says that the centres of our large business towns have, in general, been lost to gas through the want of a proper system of maintenance. "No consumer in a business office has the time, even if he possesses the knowledge and inclination, to keep a watchfu eye upon the gas fittings, and repair in due time the onslaughts of those entrusted with the cleaning of the buildings, and hence when light is required, particularly in the first of the dark days of the autumn, everything in the gas line is out of gear, and as a last resort electricity is installed, *never to come out again*." We have ventured to italicise the last phase. We learn that constant and expert watchfulness is necessary to keep *everything*—mark the word—in the gas line in repair all through the summer; and when, in despair, the enraged consumer turns to electric light, *it never comes out again*. Why? Because it is so satisfactory—it needs no attention, and whenever it is wanted, it is always ready and as bright as ever. Another satisfied consumer! The author goes on: "Walk through any shopping district in London, and note the number of lamps, both inside and out, that require attention—*most of them badly*." Quite so. That is what we have always said, in effect; but we accept Mr. Upton's dictum as being

far more weighty, for no one—not even the *Gas World*—will accuse him of being biased against gas.

In the discussion on this admirable paper, Mr. Winslow said they all had to deplore the lack of maintenance of incandescent burners. The President said that gas governors were an abomination to gas companies, and always would be; if they reduced the pressure they reduced the efficiency, and if they increased the pressure they increased the noise in the burner. Truly here is an awkward dilemma; efficient gas burners are evidently noisy ones. We knew that gas burners made a nasty noise, but we were not aware that this betokened efficiency. Mr. Clark said they could keep fairly constant pressure in the district, but not in the house; "if the cooker was lighted when the fire was on, they got three or four times the drop in pressure that was produced when only the fire was lighted. That upset the efficiency of the fire." We gather that the gas engineer's lot is not altogether a happy one, with such extravagant claims made on behalf of his commodity, and such difficulty in substantiating them.

The author received a hearty vote of thanks for his paper, and we beg respectfully to record our vote also in his favour.

While on this subject, we may add a quotation from the printed instructions supplied with a new incandescent gas burner purchased last month, and made by one of the most noted manufacturers; "it will have been observed by everybody using incandescent burners that the light becomes dull after a burner has been in use for some time." Quite true—the fact has been observed. Indeed, it is notorious. It is admitted repeatedly in the paper and discussion above mentioned, as well as by the burner maker. What, then, is the use of heroically protesting that an alleged 60-candle burner is really a 60-candle burner, when we all know that 30 or 40 candles is more like its average output? The claim is on a par with the statement that is being industriously circulated that gas lighting is more hygienic than electric lighting—truly the most impudent assertion that we have yet met with in this connection. In the *Craven Herald* for March 24th, an article was published regarding the intention of the Guardians to adopt electric lighting for the Skipton Workhouse, they being alarmed at the increasing cost of the gas bill, and objecting to the dirt resulting from leakage of gas. Evidently from an inspired source, the article says it is open to question whether electric lighting will be either as hygienic or as clean as a system of incandescent gas lighting, and goes on to quote statements, such as that of Dr. Toogood, as to the ventilating properties of gas. One "authority" audaciously says, "1 cb. ft. of gas consumes 6 cb. ft. of air, and *hence* sets up currents and motions of a wholesome kind"! We have italicised the "hence." This is, indeed, making the best of a bad job.

The Purchase of Coal by Specifications.

A VALUABLE contribution to the discussion of this subject appears in the March issue of the *Engineering Magazine*, the author being Mr. Leo Loeb, and American practice being the main topic of the article.

As one of our own contributors has pointed out, in an article upon "Fuel Purchase," published in our issue of January 7th, 1910, the American fuel-user and manufacturer, as a result of various influences (educational and otherwise), is more ready than his English brother to adopt this new method of fuel purchase, and the United States Government has given him a useful lead in the matter.

After discussing the significance of the various figures obtained in the Laboratory by a "proximate" analysis of the fuel, and by the determination of its calorific value, Mr. Loeb is able to give details of different forms of contract specification now employed in America, covering large deliveries of fuel.

Thus, the Interborough Rapid Transit Co., of Pittsburg, purchases 360,000 tons annually, of a bituminous "run of the mine" coal, upon a B.TH.U. basis of 14,100 with the following values for the proximate analysis:—Ash, 9 per cent.; fixed carbon, 71 per cent.; volatile matter, 20 per cent.; and sulphur, 1·5 per cent. Premiums and deductions are enforced for variations above and below these limits.

The coal for the Panama Canal constructional work, amounting to 650,000 tons per annum, is purchased on the B.TH.U. basis of 14,600 as received, with deductions for variations below this limit, but no premiums for deliveries showing a higher calorific value. The contract has resulted in an average delivery for 1908 of 14,547 B.TH.U., and for 1909 of 14,528.

The U.S. Government coal purchases amount to a value of $7,000,000 per annum. "Half of this is used in war vessels, and is purchased by a system of visual inspection which will not permit of wet coal being loaded, and which pays a premium for all coal showing more than 15,000 B.TH.U. dry. The remaining million tons is purchased on a *pro rata* 'as received' B.TH.U. basis, and an ash variation allowing 2 per cent., then penalising at rates increasing from 2 cents to 35 cents per ton, for from 3 per cent. to 9 per cent. ash above guarantee."

The basis of other forms of contract specification used for fuel purchase in the United States are also described, and analysed by the author. An interesting comparative statement is given, showing how closely in one case the actual results agreed with the estimated savings, based on the laboratory examination of two fuels.

The questions of sampling and of cost are finally dealt with, and on the latter subject the author states that the system of purchase on specifications has been successfully applied to an annual consumption of only 500 tons. As regards the opposition of colliery companies and of coal dealers, the author states that "if the stipulations of the contracts are fair, contractors will not hesitate; in fact, such mining companies as *employ competent fuel engineers and know the quality of their output*, solicit business on this basis."

The words we have placed in italics are the important ones in this paragraph, and we fear that the opposition of colliery companies and of colliery agents in this country, to the adoption of this new system of purchase, is to be ascribed to their lack of scientific knowledge and training.

However, the movement for the introduction of more scientific and exact methods in the sale and purchase of fuel will progress, in spite of the opposition of many of those most interested; and as the younger and better-trained generation of colliery managers and agents obtain controlling power, they will probably see the wisdom of accepting the new basis of valuation, under a form of contract which shall be equally fair to the vendor and purchaser of the fuel.

Train Lighting.

IN his report on the accident at Hawes Junction, which was recently issued, Major Pringle states that "the fact is established that the fire originated in an escape of gas from some of the cylinders carried under the first two coaches," as we surmised at the time. The gas was apparently lighted by flashing and sparking from the grinding together of steel parts of the coaches, of the wheels over the rails and ballast, and of the brake blocks upon the wheels, which Major Pringle considers amply sufficient to account for the ignition. As experiments have shown, the gas flare may have lasted two or three minutes, and may easily have engendered sufficient heat to set fire to the woodwork. He goes on to say that "it cannot be denied that there is greater liability to fire, in a railway accident of this description, when gas is used as the illuminant, than with electric light." Nevertheless, he does not condemn gas outright, alleging various advantages in its favour, and suggesting that, before entirely condemning it, steps should be taken to see whether its use can be safe-

guarded. The proposals which he puts forward to this end, such as the adoption of stronger cylinders, a decrease in their diameter, putting them upon the roof, and so on, seem to us to hold out little prospect of beneficial results, and some, such as that of using steel throughout for the construction of the coaches, are not only impracticable as applied to the enormous quantity of rolling stock in existence, which cannot be scrapped, but also involve new dangers to passengers, who could not be cut out of a steel compartment coach. However, Major Pringle comes down on the right side at the finish, when he concludes that, after taking all possible precautions, electricity will still be the safer, and, therefore, should be adopted wherever possible. This is not the first time that the Board of Trade report on a railway collision has contained the same recommendation; but nothing is done to secure its adoption by the railway companies.

Manufacturers' Specifications.

When sending out a quotation for a standard machine or appliance it is the custom with many manufacturers to enclose a so-called specification, which is supposed to indicate the construction in detail. We use the word "supposed" advisedly, as in nine cases out of ten the description of the details which really matter is not exact enough to be of any use.

Every engineer, whether he be an independent expert or permanently engaged by the prospective purchaser, stakes his reputation upon any machinery ordered on his advice, and he naturally and properly wishes to assure himself that the construction is satisfactory before the order is placed. Then, again, competitive tenders have to be compared, and it is often in the detail construction that the important differences exist.

Take, for example, a manufacturer's standard specification of a motor. Perhaps the most important point is the material used for insulation, including the varnish and any special means for getting rid of moisture and obtaining a thorough impregnation. These vital points will be covered by the useless statement that "*all parts are very carefully insulated.*" Again, bearings will be referred to as being of "*ample dimensions*," or "*long bearings*" and terminals are given "*liberal cross-section.*"

No engineer worthy of the name can afford to place an order on the strength of such general descriptions of important details. He will want to know what are the materials used for insulating the various parts, and what means are resorted to for removing moisture and preventing its return. Further, the actual dimensions of the bearings will be needed to enable him to estimate their wearing capabilities, and for comparison with offers from other makers, whilst the section of the terminals and method of locking them should interest anyone experienced in possible trouble with these parts.

On the other hand, the ventilation of the armature or the material used for magnet cores is of no consequence to the purchaser whatever, as these points are covered by the efficiency and temperature rise guarantees.

Vague specifications of this nature are quite useless, and it would be better, in the first instance, to confine the description to temperature rises, efficiencies, speeds and other necessary figures, leaving the details of the construction to be specified fully when asked for.

Presumably this vagueness is intentional, and induced by the fear of giving important dimensions and particulars, which may find their way to rival makers. Such a fear is now rather out of date, as all go-ahead manufacturers know with considerable exactness what their rivals are doing. The really important question is what your rivals will do next, as it is only the making of constant improvements which keeps one firm ahead of the others; hence those who copy are always a little out of date.

Specifications in general terms are not accepted in other industries and professions; we do not find the architect or naval designer willing to pass any but the most detailed and rigid specification of what he is going to get, and there would seem no reason why an engineer should be less exacting.

THE WORKING OF A CO_2 RECORDER.

By W. N. Y. KING.

The question, "To record CO_2 or not to record CO_2?" has been debated at various times and places without receiving an answer approaching unanimity in one way or the other. Judging by the general practice in most boiler installations of note there is a considerable balance of opinion in favour of the positive proposition, but here and there are to be found exceptions, where the authorities are sceptical as to the value of making provision for this purpose, and the argument of such is usually, not that the information to be obtained is useless, but that the expense, time, and care required are too great in proportion to the value obtained; *i.e.*, they rely upon the experience and care exercised by the firemen and the watchful supervision of the engineer to keep the conditions of firing as constant and efficient as would obtain if a CO_2 recorder were fitted up. In regard to this view the writer is of opinion that the following few remarks on the working of one such instrument (the Simmance Abady) during the last two years in connection with a battery of large water-tube boilers, mechanically stoked, with chain grates, may be of some interest.

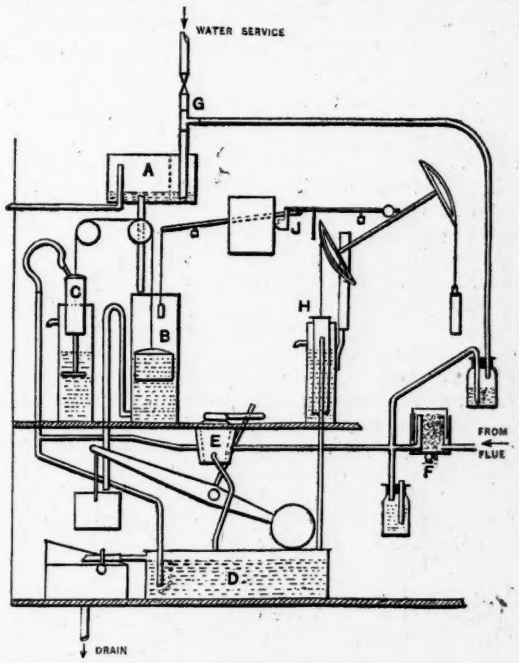


Diagram of CO_2 Recorder.

Dealing first with the *modus operandi* of the apparatus, reference must be made to the accompanying diagram. The method is an ingenious application of automatic working to the well-known Orsat process, with its patience-trying raising and lowering of bottles many times by hand to make a single determination of the percentage of CO_2, and this generally in an atmosphere so warm, dusty, and dry, that it is as well for the success of the experiments that the liquids concerned are quite unfit for human consumption. The water tank A is supplied from the ordinary domestic service, controlled by a tap to regulate the speed of working, and contains a wire screen to keep back solid matter. The water next passes into the float tank B, to supply the motive power for manipulating the gases, and, raising the float until overflow level is reached, it siphons out rapidly, emptying the tank and incidentally lowering the bucket on the end of the lever overhanging the drain tank. The float has now fallen with the water level to the bottom of the tank, but the flow of water from the supply continues, and the process is repeated continually.

The "extractor" bell C is attached to the float B, and rises and falls alternately with it. In the bell C are two openings, one below the water surface in the tank and another at the top connected by branched passages to the vessel of caustic potash D, and a special plug cock E, in such a way that when the bell rises the cock is rotated simul-

taneously by the lever and bucket, into which the water siphons, as mentioned above, causing the bell to extract flue gas from the filter F, through which a continual stream of flue gas is kept passing by means of a small ejector fitted in and actuated by the water service at G. The plug cock is rotated back again to shut off the connection between filter and extractor before the extractor bell falls, when the gas is expelled gradually under the surface of the cautic potash solution, and bubbles through it on the way to the analyser bell H. The latter is thus caused to rise up by the whole volume of gas expelled from the extractor minus the volume of CO_2 absorbed by the caustic potash, and to show the proportion of CO_2 which was present, by comparison with the distance the analyser bell would rise to, were no CO_2 present. The scale fixed beside the bell is marked in hundredths of the full height, so that the percentage is shown by the number of divisions the bell fails to pass when it reaches its maximum height.

The pen J is allowed to fall by the action of the float B rising and lifting the small weight on the end of the lever which supports the pen at the zero line. The distance the pen falls is controlled by a rod hanging vertically on the pen-arm, which comes into contact with the analyser bell-top H below. A recording chart is placed in the usual manner, so that the pen makes a short straight line for each time it acts, resulting eventually in a series of lines close together, so that the extreme points mark out the path of a curve which clearly shows how the CO_2 percentage varies. The connections between boiler flues and recorder are made with ¾ in. iron steam pipe, each boiler branch having a plug cock in it, so that one boiler only at a time may be tested.

Each pipe is carried eight or ten inches into the flue near the exit of the gases from the boiler, so as to avoid the chance of tapping more or less stagnant gases held in check by surface friction. Experience has shown that 1-in. pipe throughout would have been an improvement, requiring less frequent cleaning.

The attention necessary for satisfactory operation is entirely included in the few points now to be noted. During the passage of the gases from the extractor bell to the potash vessel, water vapour is carried over, with the result that the volume of liquid in the latter vessel is increased. If this is allowed to go on too long, say a week or more, the vessel becomes so full that the liquid is forced up into the analyser chamber. This is easily obviated by opening an india-rubber pinch-cock at the overflow level of the potash vessel, while the extractor is ascending only, so that no portion of the definite quantity of flue gas is lost, as would be the case if the pinch-cock were open while discharge was taking place from the extractor to the analyser. That extra fluid does accumulate in the potash vessel is shown by the fact that, on the daily opening of the pinch-cock, a few drops of liquid overflow.

Evaporation takes place from the extractor and analyser tanks, and this must be compensated for by the addition of a little water to each. Any overflow which may take place during this process is caught by small glass bottles standing under the overflow pipes.

The clock actuating the chart drum, is an eight-day one, and it gives no more trouble than one on any other recording instrument. The chart is renewed every 24 hours, though instruments can be arranged to carry charts for longer periods —up to 60 days, if this were desirable. For the ordinary routine, the 24-hour chart is the most suitable, because one instrument is generally installed for a group of boilers, and records are taken from one only at a time, each boiler being run for a day or two on the instrument, so that each chart presents results obtained on one boiler only.

Other points which require attention at long intervals—two or three months, say—are the flue-gas filter E and the water bottles F and G. The former contains a few ounces of white cotton waste, fairly closely packed, to absorb soot and moisture from the flue gas, and that it performs these functions is amply shown by its condition when taken out for renewal at the proper period. The water bottles require filling to the correct levels after loss by evaporation.

After about three months' working the flue-connecting pipes become wholly or partially choked with soot; this is indicated by low CO_2 percentage recorded, and by air bubbling in at the bottle F. The instrument is disconnected at a union in the flue-gas pipe and a connection made to a steam pipe so that steam may be blown through the main pipe and each boiler flue pipe separately for a few minutes, with the result that a clear passage is soon obtained.

One of the most important facts which has been shown by the CO_2 records, is that the limit of the CO_2 obtainable under satisfactory working conditions is set by the highest temperature the grates will bear without rapid deterioration; the result of too high temperatures, and these can easily be obtained, is that the grate links burn through in the course of a few hours and then allow pieces of coal and clinker to fall through and cause jamming of the grate, which becomes so serious as to lead to the breakdown of some part of the driving gear, unless the working is stopped before this climax is reached, and in either case the grate is out of commission until the necessary repairs have been made.

With the plant now under consideration it is noticeable that when the CO_2 has been kept for any length of time, say, more than 10 or 15 minutes, at a higher value than about 12 per cent., the cast-iron links of the grate have been seriously damaged by burning, and the fires along the back of the grate—where the chain passes under the air seal, arranged to keep out as much air as possible—are exceptionally fierce on account of the air entering in small jets like miniature blast furnaces. These local centres of very high temperature have the effect of burning the grate in strips, and there is a cumulative effect, one portion of the grate being burnt lower than the other, which causes fire to accumulate in the lower part, and the draught is stronger there when passing under the air seal, so that this portion burns away more rapidly than the less burnt portion of the grate. Hence it is desirable to regulate the working of the grates so that the safe limit of CO_2 is not exceeded.

The best working conditions are obtained when the fires cover the grate well, but are quite thin as they pass the air-seal; this condition also shows that little or no fuel passes out of the furnace unburnt. Any lack of care which allows thick fires to accumulate at the back of the furnace is likely to cause heavy losses in unburnt fuel, which is discarded with the ashes.

Another point observed was that, with the type of stoker employed, the CO_2 recorded for a whole day's run of 18 or 19 hours would not vary more than 1 or 2 per cent. between the maximum and minimum during the firing hours, *i.e.*, from 11 to 9 per cent. When fires were banked and fans shut down, the CO_2 would drop off gradually to 2 or 3 per cent. only. If, in case of necessity, hand-firing was resorted to, the variations shown by the charts amounted to 5 or 6 per cent. two or three times during each hour, *i.e.*, from 7 to 12 or 13 per cent. CO_2. From these observations it is evident that the engineer-in-charge has a very valuable means of control over the working of the fires, as it shows very clearly how the regulation of the fuel feed and draught are conducted, and the fireman, conscious that the record is being made, takes a greater interest in his work, with the result that considerable economy is obtained. This case is just parallel with that of motormen on tramcars which are fitted with watt-hour or ampere-hour meters to show the energy utilised in the day's run, an economy resulting from the fact that the consciousness of a record being made keeps the mind interested in making for economy.

No difficulty is experienced in getting a uniform number of records per hour, day after day, as the working cycle remains unaltered so long as the water supply is not interfered with; a very suitable chart is obtained by working at the rate of 12 or 15 strokes per hour. If the cycle is unduly shortened, the float in the tank B rises so quickly that it allows the pen to fall before the analyser bell H has risen to its proper height, so that a false reading, too high, is registered, but this is quite an easily detected fault and is equally easily remedied. On the other hand, if the water service is too slow the lines on the chart are too far apart to show the gradual variations and important fluctuations in the firing might be missed. Working at the rate mentioned above, the KOH solution, of which the vessel holds a Winchester quart, will remain of sufficient strength to give accurate readings for six or eight weeks; after this the

solution weakens perceptibly and should be renewed. One more point in conclusion: it is advisable to have the water service pipe of lead, on account of iron pipes forming rust, small particles of which may choke the small orifice of the ejector, though iron piping is quite practicable, and under certain circumstances works with very little trouble.

SOME UNCOMMON APPLICATIONS OF ELECTRIC HEATING.

By G. BASIL BARHAM, A.M.I.E.E.

Every electrical contractor is fully aware of the many domestic operations to which electrical energy may be applied, especially in connection with heating and cooking. There are also a large number of industrial processes needing the application of heat, and the electrical engineer has already shown that in several of these such heating can be carried out successfully on a commercial scale by means of electricity. Many other somewhat similar processes requiring heat exist, however, to which he has not as yet given close attention, and, consequently, in these cases electric heating has only been tried experimentally, or in a few isolated and little-known instances.

There are a number of machines employed in industrial work, certain parts of which are required to be raised to a high temperature, this heating being at present accomplished by means of steam, gas or petrol. Amongst such machines may be mentioned printing presses, cardboard machines and stone and leather presses.

Taking the printing press as an example of these, it can be shown that electric heating offers many advantages compared with the use of either petrol or gas, which are usually employed for the purpose. When petrol is employed, it is impossible to heat the printing plate directly, as the heating arrangement is in the printing head, from which it has to be transmitted to the plate. There is consequently a great waste of heat, owing to the fact that the temperature of a large mass of metal has to be raised. Not only is heat wasted in this way, but the loss by radiation is exceptionally heavy. Further, petrol heating is dangerous, and a great risk of fire is introduced into the premises where it is in use, as it is impossible to keep the flame steady in a draughty printing works, or to prevent it blowing out of the holes in the head. There is also the danger and risk to be reckoned with which is always incurred in the storing of petrol, whilst, owing to the inflammability of the vapour, any accidental spilling of the liquid is almost certain to result in explosion. Gas is not so dangerous as petrol, and it is more largely used in printing works, but the other disadvantages enumerated above are present when it is used.

On the Continent the danger and inefficiency of any form of flame heating are now being recognised, and at least one manufacturer has turned his attention to electric heating, and has begun to grapple with the problems it presents. Other firms are also experimenting with different forms of heaters for use with large presses, and are meeting with considerable success. As a matter of fact, presses can now be obtained in which the heating is carried out electrically. The heating elements, electrically insulated in the usual way, are embedded in a plate which is provided with slots and so can be screwed to the bottom of the main plate. The principal advantage of this arrangement is its superior efficiency, as the heat is produced just where it is wanted. There is no necessity to heat up a large mass of metal, and very little heat, comparatively speaking, is wasted through radiation. A further advantage may be also pointed out, which is that there is ample space available for the heating elements. There is no necessity, therefore, to throw a heavy electrical strain upon them, as would be the case if they had to be made of smaller dimensions, but were required to give out the same amount of heat.

In an alternative arrangement, the heating elements are inserted in the existing holes in the printing head. This is certainly the simpler method, and one that necessitates but little alteration to the existing patterns of machines. On the other hand, it is less efficient, and does not compare favourably with the former system as regards economy. It will be seen that when this arrangement is adopted, it is necessary to heat up the whole printing head, and the consumption of electrical energy is high in consequence, whilst the loss by radiation is considerable. Unless electricity is obtainable at an exceptionally low cost, it is probable that, on the ground of expense alone, this method of heating would not compare favourably with either petrol or gas heating. At the same time, however, the greater cleanliness and the immunity from explosion or fire obtained by the use of electricity must be taken into account. A further point that must be mentioned is that, with the latter arrangement, the space available for the heating elements is cramped and the heaters have to be constructed to bear a greater strain electrically in order to raise them to an adequate temperature. For this reason there is a greater risk of breakdown than when the separate heating plate is used. It will be seen, therefore, that, although this more or less makeshift method of heating is simpler, and from the point of view of first cost, cheaper, the system first described will certainly give the best results.

In connection with laundry work, a very large field offers itself to the electrical engineer. The general criticism up to the present is that most electrically-heated appliances take too long in reaching their maximum temperature to be ever really valuable to the launderer. For general purposes what is wanted is a heating device which can be overrun considerably when first placed in circuit, in order that a high initial temperature may be obtained. Further, both proprietor and operator look askance at the flexible cord attachment which is usually fitted to the irons that are offered for use in laundries. It is, curiously enough, far more troublesome than the armoured flexible gas pipe which is used in a competitive system of heating: it has a tendency to kink, and is, moreover, somewhat easily damaged. A useful attachment, which might assist to break down the prejudice which undoubtedly exists against electrical appliances in laundries, would consist of a length of flexible run inside an armoured rubber tube, with a connection at each end, such connection to consist of a simple durable plug. At one end of the flexible a male, and at the other a female, plug would, of course, be used. But the electric iron does not exhaust the possibilities of electric heating in laundry work. Where energy can be generated cheaply, immersion coils and heaters can be used for boiling, especially in cases where it is convenient to fix a boiler some distance away from the main boiler. Many engineers forget when considering such a proposition that the only question is that of efficiency, and that, given an efficient machine and an efficient heating device, the energy loss is far from high, and may easily be less than that which would be incurred were a boiler badly set, or a furnace or flue faultily designed. The heating of large quantities of water is certainly a difficult problem, but only on account of the large amount of energy required. Given cheap electricity, there remains no further obstacle, and the high heat efficiency of electric as compared with other methods of heating should in itself be sufficient to secure its adoption.

In the paper-making, textile and other industries large use is made of hollow rollers and drums built up of sheet-iron and end disks which have to be heated. At present this heating is carried out by either gas, petrol or steam, the latter being the most generally used. With gas or petro there is grave danger of fire, and consequently they are now seldom employed as heating agents except in such positions or under such conditions as render it almost impossible for them to be a source of fire risk. Where steam is used, it is conveyed to the roller or drum by piping, and even where this piping is carefully lagged there is a serious loss of heat. Where the drum is a long way from the boiler the loss of heat in passing along the piping may easily be as great as, or greater than, the heat actually required for the work which is being done. Where steam is used the labour costs are high, as it is almost impossible to keep the joints between a pipe and a revolving cylinder steam tight, so that constant attention to the heating plant is required. The removal of condensed steam from the drums and piping has

also to be taken into consideration. With electric heating all that is needed is a suitable contact device between the leads and the heaters inside the cylinder, and the heat can be obtained, regulated and shut off when desired without the slightest trouble or interference with the work carried on. The cleanliness of electric, as compared with other methods of heating, is a further point in its favour in connection with the textile industries.

Every engineer is aware that small electrically-heated ovens have successfully demonstrated their value, and proved that electric cooking is not the expensive luxury that it was at one time considered to be. Indeed, they are growing so rapidly in popularity, that a description of them would be out of place in this article. But from the small domestic oven to the bakehouse is a far cry, and probably few engineers in this country are aware that on the Continent there are a number of large bakeries in which electricity is the only method of heating adopted. At present, as may be supposed, electrically-heated bakers' ovens can only be used commercially in districts where, as in many parts of Switzerland, electrical energy is obtainable at a cheap rate. At the same time the convenience, cleanliness and great range of regulation possible with electricity are so great as to constitute powerful arguments in favour of electrically-heated bakehouses, even in localities where electricity costs money and cannot be obtained for next to nothing.

The large bakery equipped in Bregenz has a baking surface of about 6 ft. 7 in. × 19 ft. 8 in., or about 14 sq. yd. This surface is, however, divided into two storeys placed one above the other. The controlling switches are mounted on a switchboard placed beneath the doors of the oven and shielded from the heat by a protective screen.

Each of the two storeys of the oven is controlled by ten switches, which are so arranged that their positions on the board correspond to the positions in the ovens of the heating elements they control. The elements are so arranged that when they are all in operation the heat is absolutely evenly distributed, and a careful temperature test will show no difference in heat between any parts of the oven. It can therefore be seen that, with 20 circuits for the two storeys, the heating can be adjusted within very wide limits, and it is not only possible to reduce it from full to zero all over the oven, but to raise any desired parts of the latter to a high local temperature, whilst the remainder of it continues comparatively cool. As may be supposed, ordinary thermometers are useless, and in order to show the temperature inside, pyrometers are fitted in the front of the oven. The oven is lighted electrically by means of incandescent lamps, but as the bulbs of these would not stand the heat were they fixed inside the oven, openings are provided at the right-hand side of the doors. An electrically heated steaming apparatus is provided on each storey, as steam is required when dealing with certain kinds of bread, and in connection with the ovens, a large water tank has been installed which supplies all the hot water needed for the domestic operations carried on in the adjoining house as well as that required in the bakery itself.

From a commercial point of view, the electric bakery is superior to any other type on account of the large output of which it is capable. It is so quickly put in operation, and can be so easily regulated and controlled that the time during which it is necessary for it to be in service to deal with a given output is about 47 per cent. of that which would be necessary with an oven heated in the ordinary way. Consequently, the output of the bakery can be increased, or the cost of labour greatly reduced, according to circumstances.

As far as the writer is aware, no serious suggestion as yet has been made that steam engine boilers should be electrically heated. But boilers designed to produce steam for use in many industrial operations have been designed, and are actually on the market, which are heated solely by electricity. The makers of these state that they are highly efficient, claiming that 90 per cent. of the energy supplied is transformed into useful heat. With such appliances, again, the great convenience of electric heating, especially as regards its instant availability when required, and the fact that it can be switched off without loss when not wanted, is a powerful argument in favour of its adoption in localities where a cheap and plentiful supply of energy is procurable.

ENGINEERS' AGREEMENTS WITH LOCAL AUTHORITIES.

Letters which appear from time to time in our "Correspondence" columns afford indications that agreements between engineers and local authorities are not always fraught with unalloyed blessing to all the parties concerned. Apart from questions as to salary, terms of service, length of notice, &c., there are often difficulties of a formidable nature arising from the fact that the engineer to a local authority has to be the servant of many masters. He may be appointed by the "party in power" for the time being; and when the pendulum swings back, the other side, assuming the reins of office, may desire to get rid of him. In these circumstances, it is manifest that great care should be exercised in drawing up the necessary agreement between the parties.

Electrical engineers are in no better position than their fellows in other branches, for there is keen competition for all the jobs which happen to be advertised. Where there are many candidates, those who think they are in the running are less critical of the terms and conditions which it is sought to impose; and the successful applicant for the post of resident engineer sometimes finds—only too late—that he has become bound by onerous conditions which render his duties unbearable. Last, but not least, he may even find that the local authority is bound by no contract which can be enforced against it.

To commence with the last point first—as it is the most important of all—it is almost essential that, in contracting with a local authority, the contract shall be in writing and under seal. A case which was recently heard in the King's Bench Division serves to illustrate the danger of doing work for a local authority on any other terms. It related to the employment of an architect, whose position, for this purpose, is very similar to that of an engineer. It appears that the plaintiff, Hodge, and one Nuttall, were virtually employed by the defendants, the Urban District Council of Matlock Bath, as joint architects for the erection of a kursaal. The plaintiff prepared plans and did certain work, but before completion he was dismissed. He then sued for damages for breach of contract. Damages having been awarded by a jury at the Derby Assizes, the defendants objected that there was no contract under seal.

The Public Health Act, 1875, Sec. 174 (1), provides that every contract made by an urban authority, whereof the value or amount exceeds £50, shall be in writing and sealed with the common seal of such authority. It was contended that in the circumstances of the case, the architect should have had a contract under seal. Mr. Justice A. T. Lawrence held that as the defendants had had the benefit of the plaintiff's work, he could recover £230 as on a *quantum meruit*, *i.e.*, on the footing that he done work for which he was entitled to be paid. His Lordship held that the defendants could not take the benefit of work done in an employment within the scope of their authority and for the purposes for which they were created, and then refuse to pay for it. This case has, we believe, been carried to the Court of Appeal, where a new trial was ordered; but whatever its ultimate result, it illustrates the desirability of having agreements reduced to writing.

In Mayor of Ludlow *v.* Charlton, 6 M. and W. 815, it was held that a municipal corporation was not liable for the costs of certain building alterations and improvements in the borough, executed under an order given at a corporate meeting and entered in the corporate books, but not under seal. So, again, an agreement confirmed by a resolution of a board of directors for building cottages upon the land of a railway company was disallowed, as no formal contract had been entered into. Again, in Start *v.* West Mersea School Board, 1899, 63 J.P. 440, an architect had been requested by a school board to prepare plans for the enlargement of a school, and to act as clerk of the works and superintend the construction of the building. He prepared plans, but the lowest tender was for a larger sum than was estimated, and another architect was engaged, who carried out the work. In an action by the first architect for professional services rendered, a jury found in his favour; but Mr. Justice Wills, on further consideration, ruled that

as the agreement was not under seal, the plaintiff was not entitled to recover.

This decision appears to be inconsistent with that in Clarke *v.* Cuckfield Union, where a rural district council employed the plaintiff, though not under their common seal, as an engineer to prepare plans and do other work in connection with a sewerage scheme, which they were about to carry out, for a certain area. The plaintiff duly did the work and the council accepted it. In an action to recover remuneration for his work and services, it was held by the Court of Appeal that as the work and services had been accepted by the council, the law implied a contract to pay for them, and the absence of the seal was no answer to the claim (Lawford *v.* Billericay R.D.C. (1903), 1 K.B. 772).

This was the decision followed by Mr. A. T. Lawrence in coming to the conclusion that the plaintiff, in the case before him, could recover something. It is clear, however, that there is great danger in not insisting on a contract being under seal. When the questions—How much has been done? and What is the value of the work done? have to be gone into, it may turn out that the engineer gets very little for his pains, and much of the amount which he claims may be swallowed up in costs. The golden rule should therefore be, to have an agreement drawn up in writing, and to have the advice of a solicitor before signing it.

THE ECONOMICAL DISTRIBUTION OF MAINS.

[COMMUNICATED.]

Without exception, the hardest of all the problems in electrical engineering is the problem of economy in respect of the distribution of mains for the supply of electrical energy.

There are three great points to be examined if any attempt is made to study the problem, namely: present demand, the possibility of increased demand in the future, and the balancing of the system; and each of these points must be examined for two cases: first, the case of the private consumer, and secondly, the case of a whole street or of a number of consumers. All of these call for most careful deliberation, more especially since no one point can safely be considered without keeping in mind the others also.

The case of the private consumer would naturally appear to be simpler than the case of a whole street, and this is actually so.

Take, for instance, an ordinary shop which is about to be electrically lighted. The consumer's present demand and the possibilities of the future are, in this case, easy to determine, even admitting that heating and cooking by electricity are, as yet, not far developed; but if he be a large consumer on a three-wire D.C. distribution, for instance, the question of balancing of load will immediately crop up. This point, however, is quite insignificant compared with some of the problems which mains engineers have to contend with.

On power circuits for private consumers difficulties have to be surmounted which are very trying to an average man. It is, for instance, a frequent occurrence that a prospective consumer will try one small motor first of all as an experiment, before finally deciding to have his whole workshop electrically driven. In a case such as this, the mains engineer is quite at sea.

He is suddenly called upon for a supply for, say, a 10-H.P. motor, with no warning that, if satisfaction is derived, the demand will increase three or fourfold, and he often lays his mains accordingly.

After a period of perhaps six months, the consumer, having realised the enormous advantages of electrically driven machinery, decides to convert the whole of his workshop, which may mean an addition of another 50 or 60 H.P. The mains originally laid are now too small, and either they must be changed or extra ones put in. If the latter course is taken, additional meters are required, which is not always advisable, while the cost of changing mains once installed is heavier than the cost of laying a new main, should this be deemed the better method. If, on the other hand, the engineer had anticipated the increased load and laid a heavy cable specially for it, it is more than probable that the consumer would have taken six years instead of six months to find out the best means of driving his machines.

The writer is of the opinion that wherever there is a workshop, the machinery of which is about to be partly driven by electricity, the mains engineer should make ample provision for driving the remainder of the machinery in the event of its being converted. The cost of the service would be higher, since the heavier cable would be more expensive, but even if the full load did not come on for another five years, he would have nothing to repent of, since he could set against his higher service cost the decreased annual copper loss in the larger cable. It may seem arguing on very thin lines to suggest such a compensation as the latter, but it has been the privilege of the writer to observe that the energy loss in cables is a much more serious affair than would appear upon the face of it, although these units have only to be reckoned for at generating cost.

If this is so, as undoubtedly it is, it would seem that the overloading of a cable under any circumstances whatever, would be a thing to be avoided; but this again is a point that calls for the wise discretion of the engineer. The writer calls to mind a certain consumer, who, for about three days a year, required a supply at least three times as great as his demand during any other portion of the year. The cable which was run into his premises would, during the three special days, be carrying a current of from 25 per cent. to 35 per cent. above its normal carrying capacity, and it is the contention of the writer that in such a case this is perfectly legitimate, especially when it is pointed out that the period of maximum demand would only cover about five hours.

The question of the overloading of cables cannot be fully discussed in this short article, but having mentioned the above case, it is necessary to bear in mind the fact that tables relating to cables are drawn up for continuous working, and, therefore, a cable which has 19 hours in which to cool can safely be overloaded for the remaining five hours to the extent of 30 per cent.

The problem of demand cannot be finally left without a note on another kind of worry that the mains engineer is subject to, namely, the alteration in the type of consumer, with a consequent change in demand. Quite a number of mains have recently had to be changed through ordinary shops having closed, while in their places have sprung up such buildings as cinematograph theatres, which require from five to ten times the current consumed by the late shopkeeper. The above is, perhaps, the most striking instance of this kind of thing, but it is by no means the only one. The writer calls to mind a small tailor's shop with only one floor, of not more than 500 sq. ft. area, which is utilising nightly a current of about 60 amperes, whereas it replaced a shop which was satisfied with the illumination produced by a current of not more than 5 amperes. The light craze is pleasing to the company as a whole, but is often the reverse to the mains engineer.

The question of balancing for private power consumers often assumes, in A.C. working, a special aspect, since, in certain cases, it concerns the motor itself and the registration of the energy used. The following is a typical example: A certain consumer has a motor on a two-phase, four-wire circuit, but the supply company, unfortunately, do not run both phases of their supply down the street in which this particular consumer resides. The result is that one of the cables laid to the consumer's premises has a run of quite 20 times the distance the second cable is laid. This produces an appreciable difference in volts across the two phases respectively at the motor terminals. The motor, unfortunately, is of a type that is particularly sensitive to such small differences, and complications and peculiarities abound in that motor. Surely the drop in the longer cable should have been anticipated, and compensation in the shape of a little extra copper allowed; but this appears to have been entirely overlooked, since the cable with the longer run is actually smaller than the other.

The other side of the question of balancing for private power consumers, although so essential, calls for little comment, as any information that is needed on this point can be found in the text-books dealing with the subject.

The greatest difficulties it is possible to imagine soon appear when the engineer gives his mind to the supply of a street or a group of streets. In a certain street in one of the metropolitan boroughs there are some 200 private houses, and out of this number there are about 60 which take a supply of electrical energy. It is a fairly new street, but within the last three years less than 20 of the consumers have been added, the other 40 having come on all at once shortly after the completion of the street. There is a great likelihood just at present of nearly another 100 of these houses taking a supply of electricity, which would mean a total of 70 per cent. It is unlikely that in such a street this percentage would ever be exceeded, and it is only the advent of the metallic-filament lamp which has been the cause of the additional 100 occupiers making application for a supply.

Had the mains engineer been content to lay a cable just large enough for his original 40 consumers, he would have had his hands rather full just at present. It is the opinion of the writer that in streets such as these, the mains engineer should invariably allow for at least 60 per cent. of the people residing in the street becoming consumers of electric light.

There is, however, another point which suggests itself from the previous paragraph, namely, the advent of the metal-filament lamp: continual improvements are taking place—how is the mains engineer to allow for these? He certainly knows that everything which will tend to increase his number of consumers, will also reduce, as far as lighting is concerned, the consumption by each one, but the writer anticipates the time when the gas-stove will be superseded by the electric cooker, and when much more use will be made of electric heating. How can the engineer possibly allow for such contingencies as these? If there is any problem which requires more approximation before a solution can be arrived at, the writer would very much like to see it.

The balancing of networks is very fully dealt with in various text-books, so that there is not much to be said about it. It often, however, becomes a much more complicated problem than would be suggested by those text-books, especially in cases of A.C. two or three-phase working. The fact must not be overlooked that the number of streets which have but a single-phase supply is often far in excess of the number with a two or three-phase supply, and heavy loads often crop up just where they are not wanted. The writer calls to mind a large residential district, which was fed almost exclusively off single-phase, and where it was found necessary to install an additional transformer in order that the voltage might be kept up to standard. How often does one see such a problem as that mentioned in text-books, with its effects on the balancing fully discussed! Perhaps, however, the engineer is more guided by the economy of copper point than by the actual demands for supply that he has before him. It is a case for speculation as to how many engineers would run a cable 100 yards with the idea of balancing the load, while, by coming from another phase, and slightly more unbalancing the system, one could save, say, 50 yards of cable. Again, from a copper loss point of view, once more, would it always pay him? The answer must necessarily depend upon circumstances, but there certainly are occasions when it would not.

Although he has not by any means exhausted the subject the writer feels he must curtail this article, but would like, in conclusion, to collect all the points dealt with above and to place them under the single heading of "Economy"—which necessarily embraces them all. Economy is not necessarily cheapness, and the object of this article has been to endeavour to point out that it does not always pay to use odd lengths of cable that may be laying about, whether they be of large section or small; and, finally, it must be remembered that economy and efficiency walk hand in hand, and therefore a system of mains laid on economical lines must necessarily be efficient.

Leigh Electric Lighting.—In consequence of the growing demand for energy, the Electricity Committee proposes enlarging the works, at a cost of nearly £6,000.

THE PARIS FLOODS OF 1910 AND THEIR EFFECTS ON ELECTRICAL APPARATUS.

ALTHOUGH over a year has elapsed since the disastrous floods in and around Paris suspended the normal life of the French metropolis, official and authoritative accounts of the fight of the electrical men against the rising water have only recently begun to be discussed at the meetings of French electrical societies. It must be remembered that the great extent of the damage done was responsible for the long delay in again starting up the different electrical plants, the resources of public and private bodies being taxed to the utmost, first in drying out the machines which had been left in place when the water invaded the installations, and secondly, in connecting up the apparatus which had been hurriedly removed from its permanent place in order to avoid flooding.

The present article may serve to indicate the useful measures which can be taken by those whose plant or stations are not already protected against the invasion of water. It may first of all be of interest to cite some figures to show the extent of the damage done to some of the large companies in and around Paris by the 1910 floods.

On the Orleans Railway, without including the material affected other than electrical, there was submerged the following:—Over 60 traction motors and spares, 200 cars equipped with train lighting apparatus (Stone system), 20 cars equipped with lighting apparatus fed from the traction circuit, 20 vans with lighting accumulator batteries, about 200 cells of 1,100-ampere-hour booster battery, about 20 each of transformers and workshop motors, and a large quantity of small apparatus.

On the State Railway there was less damage to rolling stock, but as much to the fixed plant. This included 15 transformers, 12 synchronous motors, 11 generators and continuous-current motors, 4 converters, 20 shop motors, about 500 cells of booster batteries, 12 traction motors, &c. In view of these figures, it is interesting to note the time required to start service on these two railways after the water subsided. The Orleans Railway was completely in order again in 10 weeks from the maximum flood—that is, on March 4th; one month only after the water was finally expelled from the Austerlitz terminal station the service was restarted.

The State Railway, whose Invalides-Versailles line was submerged on January 26th, pumped the line dry by February 20th, and the services were started up again on March 8th.

With these figures may be quoted those referring to the electrical stations, or Secteurs, as they are termed. The Secteur de la Rive Gauche had flooded some 13 alternators, 1,000 transformers, 1,500 junction boxes, 30 section boxes. The damage was all the greater as the water invaded the place before the station was shut down, and before the plant was wholly cut out. Thus numerous shorts occurred on the distribution circuits, and liquid rheostats were formed with 3,000 volts between poles, remaining under current for four or five hours, with, of course, bad results on the material.

At the Dupont printing works 100 motors were submerged, 11 days being required for their drying out.

Altogether, the Société des Electriciens has made up its report from data relating to some 1,600 pieces of electrical apparatus which were dried out satisfactorily.

Methods of Drying and Putting into Running Order.—In a general manner everyone agrees that a preliminary washing of inundated apparatus is necessary before drying out, especially when the plant has been flooded by dirty river water, from which it often emerges covered with mud and oil. This washing must be done with plenty of water, and as soon as possible after the flood water has been removed. Where battery acid had mixed with water and attacked the windings of apparatus, there was first employed a bath of sulphuric acid at 32° strength, then the apparatus was washed in water, afterwards passed through a very weak potash bath, and finally washed again. When oil had penetrated into the windings, gasolene or benzoline was used to wash them.

There were several methods used for drying out apparatus, since the apparatus dried varied greatly in character. There was one thing very apparent, however, in all the cases—any method, properly employed, generally gave excellent results. Insulation very often suffered little or not at all, all its qualities returning after drying out the humidity, although cardboard, fibre, pressboards and thin wood insulations were mostly rendered unserviceable by reason of deformation. It was found better to remove the exterior oiled cloth coverings from windings unless they were in the first place waterproof. It was also necessary to take the apparatus apart as much as necessary to open up the windings to the action of the drying air currents. Machines of low voltage and average size could easily be dried out without being taken to pieces. The commutators of traction motors were generally taken off, and transformers had their windings bared by removing the outer coverings.

The fixed machines were generally treated differently to the portable machines, and we may conveniently divide the description into two parts.

Fixed Machinery.—Electric drying, when possible, was applied with great success, and was the most popular whenever current could be obtained for the purpose. Blowers were not, however, always obtainable, and the Orleans Railway Co., which made but small application of the system for this reason, found that the time

required was much more than ordinary stoving. There is no need here to discuss at length the usual methods employed in electrical drying. The transformers had their low-pressure windings short-circuited, and the high-pressure windings were used to pass a low-pressure current through. Induction motors were treated in a similar manner. Continuous-current machines and the fields of alternators presented more difficulty. It was necessary to use a very low-pressure current compared with that used in the drying apparatus. Boosters were found very useful for this purpose in view of the possibility of varying the current within large limits.

In drying armatures it is necessary to keep them turning, in order to avoid deformations of commutators. Converters were fed at normal voltage, and each field coil was fed separately at low pressure, the machine running then slowly as a motor, sufficient current being obtained for drying by closing the rings on a circuit with small resistance, such as that obtained with iron wire.

When electric drying was not practicable, and it was found prudent also not to start it immediately after immersion, hot air drying was the next best thing. After washing with water and then with gasolene or benzoline, water was removed from the windings by turning the alternators, for instance, at their normal speed, taking care that no current was produced in the circuit. After 24 hours of such treatment it was noticed that mica insulation gave signs of return to its normal insulation, a marked improvement being noticed, whereas cotton-covered and insulated material did not improve at all under these conditions. Even when turned for 24 hours with fires burning beneath the windings, the cotton-insulated material did not show much sign of improvement. It was only after building an oven around a machine and heating the air with coke fires that after five days at a temperature of 170° to 185° F., or 70° to 80° C., the insulation was completely restored. The field coils were each displaced twice during this time to bring to the hottest part all the coils which had been immersed. The insulation resistance exceeded several megohms before the machines were run, short-circuited, at their usual output for a period of 20 hours, then at 20 per cent. overload for four hours. After a final test the machines were coupled up for service without accident.

Another type of alternator, with cotton-insulated armatures and mica-insulated field coils, was treated in a similar manner, and although the armatures gave good results, the field coils showed no improvement in their insulating qualities, even after a prolonged heating and drying.

Each field coil therefore was dismounted and immersed for 12 hours in alcohol, then dried in air, the poles being taken to a special oven. This treatment gave good results, although sometimes five days were requisite before the results were obtained.

In other cases a combined treatment of hot air, electric current and brazing lamp was used. The results were very rapidly obtained, but this treatment was not applicable to large machines.

Portable Machinery.—In this case the choice of drying methods lies between simple stoving and stoving in a partial vacuum. Each method has its partisans. In the first case, the procedure was generally to heat the ovens by gas or steam jacket. The pressure of steam in some of the larger installations of this kind was as much as 110 lb. per sq. in., and a temperature inside the ovens of 110° to 125° C. was maintained, never exceeding 130° C. This temperature is not excessive, judging from results. Cotton insulation commences to discolour only when the heat exceeds 150° C. The results observed in the case of armatures of traction motors were as follows:—The insulation, at first of zero value, rose rapidly to 60,000 ohms, and then slowly, during 24 to 36 hours, from 60,000 to 200,000 ohms. Ten hours afterwards 1·5 to 2 megohms insulation resistance was arrived at. Field coils were treated in a similar manner.

Train lighting equipments were also baked in an oven, but the temperature was not allowed to exceed 65° to 70° C. The length of the stoving process varied between 100 hours for the armatures and 150 hours for the fields.

The State Railway employed with success the vacuum treatment for drying, the temperature of the oven being maintained at 75° C., and the vacuum being pushed as far as possible, some few millimetres of mercury being attained. As an example of the success of this treatment, there may be cited the cases of some continuous-current generators of 60 KW. at 120 volts, which in 12 to 16 hours attained an insulation resistance of more than a megohm. Some pump motors were also treated in this way, and were started up for service 24 hours after the water had left the station where the pumps were flooded.

The results are all the more remarkable when it is remembered that many of the machines thus treated were of quite long service and had been in the mud and water for two months (and more in the case of the Nord-Sud tube railway), and the treatment was only commenced some days after their removal from the water. The delay in treating the apparatus after taking it from the water increases proportionately, it is stated, the length of the drying process.

The vacuum drying process also gives some indication of the amount of water absorbed by the various machines, since the water is collected during the operation. Thus, a 60-KW. continuous-current generator gave up something like 2 gallons of water from the windings.

Some useful information is afforded by a comparison of the various methods of drying-out apparatus. The Orleans Railway Co. gave some of their apparatus to the constructors to dry out, and no good results were obtained from the baking at 65° C., to which it was subjected in their works. The Orleans Co., on their own responsibility, had the temperature raised to 100° C. before the insulation resistance gave signs of returning to the normal.

On the other hand, the State Railway sent some of their 10-H.P. motors to be baked by the makers, and in the process the windings were entirely destroyed by the hot-air ovens used. No one process was completely successful in all cases. It would succeed in one district and fail in another; the failures have been attributed to too high a vacuum, excessive temperature, or insufficiently taking the machines to pieces. On the other hand, the conditions arising in this inundation were very unusual, and it was only natural that certain attempts, and especially the first, should fail. It has been pointed out that the relatively small success attending the drying out at a temperature not exceeding 65° is due to the small amount by which the pressure of water expanding at this temperature into water vapour exceeds that of the surrounding air, whereas, at 90° C., the coefficient of expansion is three to four times as much, which also explains the success attending the use of a partial vacuum for drying. It is believed that hot-air treatment at 115° C. is equivalent to a treatment at 90° C. if vacuum is used to help the process.

On the whole, the percentage of failures in the drying-out process was very small, and in this connection it is of interest to note that the period of immersion does not appear to have great influence; even water acidulated to a strength of 10° or 15° was not very deleterious to the insulation, on condition, however, that the cleaning and drying treatment was commenced immediately the apparatus was taken from the water. When the windings were left exposed to the open air after immersion, for a period of 15 days to three weeks, the rewinding of the coils was found to be absolutely necessary. Among the machines which present the greatest difficulty in respect to drying, transformers take the first place, chiefly by reason of the thickness of their windings and the difficulty in ascertaining the quality of the insulation of the interior layers of the windings.

Leaving the question of generating machinery, we come to the wiring and cabling and third-rail insulation. On the State Railway, the Invalides-Versailles line has its third rail insulated with paraffined wood blocks. After cleaning them, it was found necessary to replace only about 5 per cent. of these blocks.

As regards cables in general, it may be said that rubber-insulated cables when new, and with a waterproofed exterior coating, stand inundation pretty well, even prolonged immersion not having the effect of breaking down the insulation. The reverse is the case after the cables have seen a few years' service. They have had to be replaced entirely, especially those where the pressure reaches several hundred volts. The Sewer Department in Paris was obliged to replace a lead-covered rubber-insulated cable which had only seen four years' service at 440 volts, the water having penetrated through the interstices of the lead. On the other hand, the same Department was able to put into service after testing with a small voltage, or cleaning with scrubbing brush, other cables of the same kind operating at 110 volts, and installed some 10 years before. These various cables had been submerged for a period of 10 to 20 days. The Sewer Department attributes the success in all cases to the fact that the cables were passed through porcelain insulating blocks, the ends of the cables being well insulated by tape or compound. Cables placed in paraffined wood mouldings, even when lead covered, did not give such good results in starting up, and often had to be replaced.

The use of brass screws and bolts is preferable to iron whenever apparatus is subject to flooding for any length of time, in view of the oxidation of the iron parts when employed in connection with the fixing of cables or other apparatus, which deteriorates the insulating coverings, and renders the apparatus more difficult to take to pieces.

Conductors passed through metallic tubes with interior insulation suffered greatly from the inundations. Complete disassembling was essential, and the inner insulating lining of the tubes was entirely deformed, necessitating replacement.

As regards paper-insulated cable, with lead covering or similarly armoured, this class of cables is particularly interesting in view of its large application for high pressures. In a general way it supported immersion very well indeed, even a month under water being insufficient to break down the insulation. Very little water penetrated through the lead coverings, even a single thickness resisting the action of the water. When the joint boxes were in good condition, the small amount of water filtering through the joints was insufficient to affect the cables, even when the head of water above the apparatus was several feet. A careful inspection of the joint boxes, and replacement of a few, was sufficient to justify immediately starting up in service. It was found that where the water penetrated paper cables it was between the copper conductor and its immediate insulation for a distance of, perhaps, 25 to 30 ft. from the ends of the cable. A few yards of cable replaced was all that was necessary at these points.

Switchboard apparatus did not suffer greatly. However, contact pieces of apparatus which were under current when reached by the water suffered a great deal by electrolysis, and small coils generally had to be replaced, except when enamelled wire insulation was used.

Accumulators endured the inundations in a very remarkable manner. The State Railway had a battery which was covered for seven or eight hours by 10 ft. of water, and yet afterwards gave a 10 hours' discharge, and the acid of the batteries had not suffered any noticeable dilution. No deterioration of the cells was found to have taken place in any accumulator battery, and after cleaning and replacing the electrolyte and charging the accumulators, normal service was resumed without any noticeable loss in capacity due to immersion. The Orleans Railway Co. had sectioned their 600-volt booster traction accumulator battery before the water reached its level, so that each group gave no more than 50 volts. In spite of this precaution, traces of short circuits were observable at the terminals when the water subsided.

ARC-LAMP ELECTRODES.*

By A. MAHLKE.

The development of arc-lamp electrodes has taken place chiefly in Germany, from which country more than 10,000,000 lb. of carbon electrodes are exported annually. Much of the product finds its way into the United States, although the electrodes manufactured in this country have improved very much during the last few years. Since the raw material necessary for the manufacture of arc-lamp electrodes is found in abundance in this country (U.S.A.), and inasmuch as it is also very much cheaper here than abroad, it may be predicted confidently that in the near future all the carbon electrodes burned in this country will also be manufactured here.

If one does not take into account the usual homogeneous carbon electrodes for direct-current enclosed arc lamps, which are expected to disappear in the near future, arc-lamp electrodes may be said to consist of a shell made of different kinds of carbon material and a core containing principally metallic salts for supporting the arc. The shell is intended as a conductor of electricity, the core usually being a bad conductor and sometimes even an insulator when it is cold; but when the core is raised to a high temperature it becomes conducting. For this reason at the hot end of the electrode the current has to jump from the shell to the core, forming the arc as indicated in fig. 1.

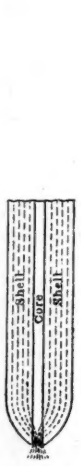


Fig. 1.—Cored Electrode.

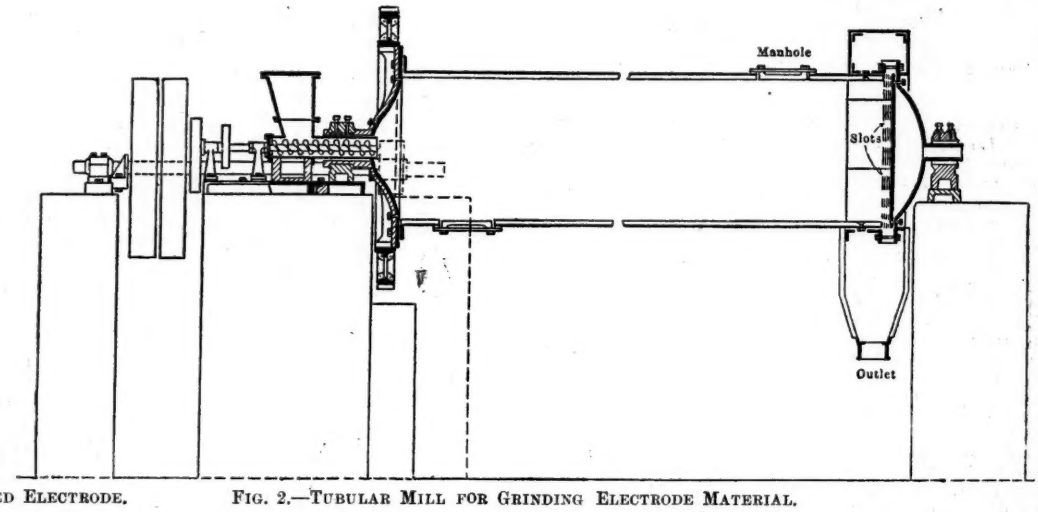


Fig. 2.—Tubular Mill for Grinding Electrode Material.

It is of the greatest importance, if steadiness of light is desired, that the arc be not fed from any point other than the end of the core. If there is any dirt in the shell which could support the arc the latter would jump to it from the core, and there would be a variation in the light and in the voltage of the lamp. Therefore, it is necessary to exercise the greatest cleanliness in making arc-lamp carbon electrodes, although one would not be so impressed with the necessity for cleanliness from cursory inspection of a carbon factory. Especially in working up the raw materials for the carbon shells must great care be exercised to keep them pure. This is somewhat difficult, because these materials have to undergo a long series of processes. The material must first be ground very fine; then the powder has to be mixed with some binder, and the resulting mixture must be stamped and pressed into the shape of the carbon shells. These carbon shells, being yet in a green state, are next packed into a furnace and baked at a high temperature; then they are shaped into various forms, and finally provided with a core.

Composition of Shell.

Of the raw materials for arc-lamp electrode manufacture lampblack is the most important. The lampblack used for electrodes is made by burning suitable derivatives of tar in a pan, to which no more air is admitted than is necessary for supporting the flame. Usually for this purpose tar oils are employed which have been distilled from tar at temperatures between 240° C. and 270° C. The dense vapours arising from the pan are conducted through a series of chambers, where the lampblack is deposited on the walls and ceilings. After the run is finished, the lampblack is collected from the chambers. But there are different kinds of lampblack in the different chambers, which must be kept separate, the various kinds being of lower or higher weight, according to their fineness or to the amount of water and oil contained in them.

Lampblack for arc-lamp electrodes should not contain more than 0·5 per cent. of water and oil. If this amount is exceeded, the excess has to be evaporated by heating the lampblack. The limit for ash which the lampblack may contain is much lower. For first-class electrodes lampblack containing more than 0·02 per cent. of ash cannot be used. In this country much lampblack is produced from natural gas. This lampblack is generally used for making printing ink and paints. Although it would be very valuable for making arc-lamp electrodes, the author does not know whether it has ever been tried for this purpose.

Tar is another material of great importance in the carbon industry. Usually coal tar is employed, but petroleum tar may also be used. The tar sold by the gas companies must be first cleaned if it is not supplied in a pure state. This cleansing is performed by filter presses, in which the tar is forced under a pressure of about 100 lb. per sq. in. through a filter cloth. For rendering the tar more viscous it is either heated or diluted with benzole. In this way the tar is separated from all solid particles contained in it. In Germany revolving separators are sometimes used to effect the same end.

The tar thus prepared should not contain more than 0·02 per cent. of ash if it is to be used for making arc-lamp electrodes. But before being available for that purpose it has to be freed from water and from those components having a low boiling point. The evaporation of these is effected by heating the tar by steam coils for several hours in a vessel open to the air. The actual time will depend on the amount of tar to be treated. If the tar be kept at a temperature a little below the usual boiling point of water, it will be freed from nearly all the water, from the oils which volatilise at low temperatures and also from naphthaline, which condenses like snow around the vessel. After this operation the tar will contain less than 1 per cent. of water. By being distilled up to 300° C. about 20 per cent. of volatile matter will pass off, and after being heated to red heat, when no more vapours are given off, there will be a solid residue of about 30 per cent. of the original bulk. These figures may vary by several per cent. for different kinds of tar.

Besides tar, pitch is also used as a binder in making carbon electrodes in this country. The pitch is made from tar, which is cleaned by forcing it through a filter press. By heating this tar, much of its volatile matter is evaporated, so that it becomes solid on cooling. The temperature to which the tar is raised is about 300° C., this value changing according to the degree of hardness which the pitch is to have. The melting point of the pitch varies from 40° C. to 90° C., depending on the kind of pitch, and the ash content is about 0·04 per cent., or a little higher than that of the pure tar.

While the materials described above are used only for first-class arc-lamp electrodes, lower-grade electrodes may be made partly out of retort coke or of petroleum coke. These materials, having a much better electric conductivity, are to be preferred by far to lampblack if they are obtainable in the same state of purity. In Europe retort and petroleum coke containing less than 0·25 per cent. of ash can be produced, but in this country the percentage of ash contained in these materials is usually much higher.

Preparation of Materials.

The first step in making carbon electrodes after having prepared the materials, is to mix lampblack and tar in suitable proportions, usually from 135 lb. to 138 lb. of tar to 100 lb. of lampblack. The mixture is moulded by hydraulic presses into cubical or cylindrical plugs nearly 1 ft. in diameter, which are then baked in a furnace at a temperature of at least 1,000° C. By raising this temperature to 1,300° C., or 1,400° C., better results are obtained. The plugs after having been cooled are crushed and ground to a find powder or flour, which is called baked lampblack.

In factories where work has to be carried on for some time, there is always a large amount of broken electrodes or carbon scrap. This scrap, when kept pure enough, after having been ground to a fine flour, is the best material for making new electrodes, and can be used instead of the baked lampblack. Both kinds of carbon flour when used for first-class electrodes must be fine enough to pass through a 200-mesh sieve.

The grinding of these materials is done in different kinds of mills, such as conical iron mills, like coffee mills or stone mills, similar to corn mills; but the best machines for this purpose are large tubular mills, like that shown in fig. 2. In this grinder the cylindrical tube is about 25 ft. long and 5 ft. wide. It is

* From the *Electrical World*.

revolved at the rate of from 25 R.P.M. to 30 R.P.M. by gearing. The cylinder is lined with soft wood and filled about one-third full with the material to be ground by means of the hopper arrangement shown at the left of the engraving. The grinding is performed by

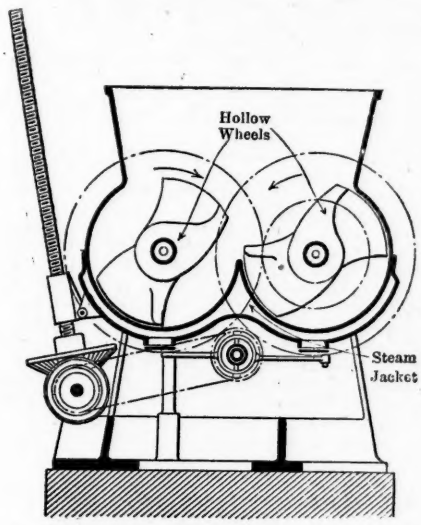


Fig. 3.—Machine for Mixing Electrode Material.

flint stones about the size of goose eggs, which are mixed with the material and grind the carbon between their surfaces as the cylinder revolves. Such material as may be ground by itself may be milled without such stones, but the process of grinding is in this case a little slower. After the mill has been used for some months the lining is renewed, and for that purpose manholes are provided in the cylinder.

A good mixture for first-class arc lamp electrodes consists of 100 lb. of raw lampblack, 100 lb. of baked lampblack of 200-mesh, made either of carbon scrap or of the plugs described above, 1 lb. boric acid and about 160 lb. of tar. The proportion of tar is changed according to the thickness of the electrodes to be made. When making thin electrodes less tar is used.

For mixing these materials a machine like that shown in fig. 3 is used. Two hollow steam-heated wheels provided with wings revolve in opposite directions in a receptacle fitted with a steam jacket at the bottom. The dry powders are first poured in and mixed, and afterward the tar is added, the wheels and receptacle being heated all the while by steam. After the lapse of an hour's operation the mixture is dumped, the receptacle being tilted around the shaft beneath the steam jacket by the mechanism shown at the left of the engraving.

In this country another mixture containing no raw lampblack, but consisting of baked lampblack only and pitch, is often used. In order to make the mixture workable a suitable amount of tar oil is added. Electrodes made from this mixture can be baked in a horizontal position in the furnace, while those electrodes containing a larger amount of raw lampblack must be baked in a vertical position, as they crack when baked in a horizontal position.

A mixture for good coke electrodes is made up of 100 lb. of 100-mesh coke flour, 100 lb. coke electrode scrap flour of the same fineness, 60 lb. 200-mesh baked lampblack, 40 lb. raw lampblack 3 lb. boric acid and about 155 lb. of tar.

(To be continued.)

The Amenities of Electrical Life in Ireland.—One of the things which mere Englishmen must learn in Ireland is that they are not at all at liberty to do what the law allows them to do in the exercise of their rights as citizens of the British Empire. There is a law still mightier than that of the Empire, and that is the law of the particular association—secret or otherwise—which rules locally. Mr. Bale, an Englishman in charge of the electric lighting of the town of Callan, in Co. Kilkenny, had the misfortune to take a house from which the previous tenant had been evicted. Thereupon the Callan Town Tenants League summoned Mr. Bale and the agent of the house to appear before it and give an account of their crimes. The agent, a Mr. Joyce, J.P., and a town councillor, too, did not appear before these self-constituted judges, but Mr. Bale did, and said he had been advised to keep the house. He was told by a member of the League that unless he gave up the house matters would be made serious for him, and the chairman told him that he and his company would be driven out of the town if he defied the League. Eventually, Mr. Bale, who evidently thought that he was in a free country, was given till a certain day to think over the matter, and Mr. Joyce was expelled from the League, of which he was member.

INSULATING TAPE.

Although many of the minor details connected with electrical engineering cannot always, owing to comparative cost, be submitted to close examination, it is always useful, both to manufacturer and purchaser, to have a series of regulation tests by which the quality of a product may be from time to time ascertained. Indeed, to the manufacturer who has gained a name for the excellence of a certain product, such tests are indispensable, to guard against the gradual deterioration of the product, owing to variation in quality of material, or omission of, or carelessness in applying, one of the processes. The largely-used material known in this country as "waterproof" tape does not appear to have received much attention in this respect, and an article by Mr. W. P. Munger on specifications and tests for this class of tape, in the *Electrical World* for February 23rd is, therefore, of especial value. Mr. Munger commences by pointing out the qualities to determine which the tests should be directed, namely, insulation, the character of the compound employed, the adhesiveness, mechanical strength, and, as a gauge of the cost, the feet length in the pound and the durability. He refers to a specification given by Mr. T. Sproule, at the September (1910) meeting of the Pennsylvania Electric Association, as a good standard one, but, unfortunately, does not give details.

As a test for the compound he recommends boiling a portion of the sample for two hours in distilled water, and testing separate portions of the aqueous extract with litmus paper for reaction, with silver nitrate and nitric acid for chlorine, and with barium chloride and hydrochloric acid for sulphur compounds, and by the cyanide method for iron.

Adhesiveness, as determined for the Stromberg-Carlson Telephone Manufacturing Co., was taken as follows:—The adhesive side of one sample was pressed on to the back of the other, and the two pressed between the jaws of a bench vice, so as to give a pressure precisely ascertainable. The strip is then clamped in jaws which can be moved apart and subjected to a steady tension. By repeated trials a length of lap will be found when the tape will break and the joint fail at the same instant. From these tests the length of splice appeared to have far less influence on the ultimate breaking strain than the adhesiveness. One specimen, having a $1\frac{3}{4}$-in. splice, took 35·9 lb., while a 12-in. splice only took 36·4 lb., and a $3\frac{1}{2}$-in., 35·9 lb. The adhesiveness was afterwards tested by drying, and only three tapes were characterised as "fairly adhesive," one being that used in the $1\frac{3}{4}$-in. splice referred to above, and the other two making $4\frac{1}{4}$ in. and $2\frac{1}{2}$ in. splices, which broke at 38 and 36·7 lb. respectively. The author's test for durability consists of suspending the samples in dry air at 220° F. for four hours, and taking the weight lost and comparative appearance.

The article terminates with a specification containing several useful clauses. In the general description the tape is required to contain no sulphur, chlorine, iron or other compounds which will act injuriously on metals or on braid. Insulation is tested by wrapping a joint and soaking it in water for 48 hours, the insulation resistance required for the joint, still in water, being 1,000 megohms. It would be simpler to test the tape dried between plates, and determine the resistance per sq. in. or per sq. centimetre, after exposure to a saturated moist atmosphere at, say, 75° or 80° C.

Adhesiveness is specified as requiring not more than 4-in. lap, when the joint fails and the tape tears simultaneously. The breaking strength of a $\frac{3}{4}$-in. tape is taken as 33 lb., the average of four lengths being allowed. The weight not to be less than 1 lb. per 150 ft. for $\frac{3}{4}$-in. tape.

The test for durability is very complete. It requires that the compound or the tape shall be insoluble in water at ordinary temperatures, and, when exposed to a moist atmosphere of approximately 90 per cent. humidity at 80° F. for 48 hours, shall not absorb more than 2 per cent. of its weight of moisture. When exposed, in strips, to dry air at 220° F. for four hours, the tape shall lose not more than 2 per cent. of its weight, and shall still be capable of making a good joint, when cooled. If kept in the ordinary package the tape shall show no marked deterioration in adhesiveness, strength or insulation at the end of one year.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment No letter can be published unless we have the writer's name and address in our possession.*

Trade Discounts to Outsiders.

It happens by coincidence that I am interested in the above firm (Envelograph Co., Ltd.); I may mention that we have nothing whatever to do with electrical engineering or supplies, and it appears to me that if we receive letters and catalogues from electrical firms in which they quote 33⅓ per cent. and a further special discount of 5 per cent., it is impossible for electrical contractors and manufacturers, with whom I am also associated, to make even reasonable profits on their business.

I take this opportunity of enclosing herewith a copy of the letter received (the original is also at your disposal, if you so desire it), with a view to bringing another of many instances before your notice of the absurd under-cutting that is ruining the industry when it is absolutely unnecessary.

Edward Dixon, *Director.*

London, W., *April 5th*, 1911.

London, E.C., April 4th, 1911.

The Envelograph Co., Ltd.,
5, Tottenham Street, W.

Dear Sirs,—Enclosed we are sending you our List No. 136, dealing with small-power motors, and we hope that you will keep same before you should you at any time purchase such class of electrical machinery.

The prices carried by our list are subject to an all-round discount of 33⅓ per cent. and a further special discount of 5 per cent.

This discount applies for orders of single motors, but should you purchase in great numbers, we shall be pleased to quote the special prices for goods delivered your address.

We have made a speciality of the manufacture of small motors, and we have no hesitation in stating that they are far superior to any other motor on the market at the same prices.

We keep a large stock, and in case of urgent deliveries we can do so on the same day as orders are received.

We keep stock of both direct and alternating current, and of all types as listed, and we solicit the favour of your inquiries and orders, which, we assure you, will receive our very best and most careful attention in every respect. Meanwhile, believe us to remain,

Yours faithfully, ——

P.S.—We also supply motors for larger powers than listed, and as soon as we receive from our printers our new list we will let you have a copy of same. Meanwhile, we will quote on receipt of particulars.

British Electrical Opportunities on the Continent.

Referring to the article, "British Trade with Switzerland," appearing in this week's issue of the ELECTRICAL REVIEW, I have recently returned from an extensive tour in Switzerland, Austria-Hungary, Roumania and Bulgaria, and I thoroughly endorse the remarks made by the British Vice-Consul at Zurich on the subject. These remarks I find are equally applicable in the case of Austria-Hungary, Roumania and Bulgaria. In each of these countries there are great opportunities for the British electrical manufacturers, and there is no reason whatever why they should not be able to compete successfully with the Germans, who at present capture the greater share of the orders.

I intend making a return and prolonged business trip to the countries mentioned, after a short visit to England, and shall be pleased to hear from interested manufacturers and to place at their disposal any information I have collected.

W. Reginald Dainty.

Nice, *April 4th*, 1911.

The Enclosed Arc or the Metal-Filament Lamp?

With reference to the article by "Pam" under the above heading, in your issue of the 31st ult., as I happen to be one of the "certain few" who have studied this question (more particularly in its connection with street lighting), I venture to criticise the comparisons made by "Pam."

After some years of experience with single enclosed arc lamps for street lighting, I find that a lamp which the makers state will consume 450 watts and give 500 C.P., actually consumes about 650 watts, also that the actual burning hours for each full trim vary from about 30 to 40, according to the state of the weather, instead of the test-room figures of 60 hours per trim given for the particular type of lamp criticised.

I have been experimenting in a small way for the past six months in making comparisons between single enclosed arc lamps of 350 C.P. and four-light special lanterns, burning 100-C.P. "Onewatt" metal-filament lamps. It was considered sufficient for the purpose of the experiment to install only two of the four-light lanterns in place of two of the single enclosed arc lamps. The power consumed by each arc lamp (350 C.P.) was 460 watts, and by each four-light lantern (400 C.P.) 410 watts; of the eight metal-filament lamps originally installed, seven are still in use, having already burned through about 2,630 hours; the single lamp which failed lasted about 1,450 hours. From these results one might safely assume an average life of 2,000 hours for each lamp; the renewals, therefore, per lantern per annum, will be eight lamps, and the cost at 3s. 5d. each, £1 7s. 4d. Hence, taking, say, 20 lamps of each type, the following comparison of working costs per annum can be drawn up:—

SINGLE ENCLOSED ARC LAMPS.

20 lamps complete, at 42s. each, = £42, 20 per cent.	£8	8	0
Attendance and carbons	21	10	0
Energy, 20 × 460 watts × 4,000 hours × 2d. per B.T.U.	306	13	4
	£336	11	4

METAL-FILAMENT LAMPS.

20 fittings complete, at 26s. each, = £26, 12½ per cent.	£3	5	0
Renewals (160 lamps) and cleaning	28	16	8
Energy, 20 × 410 watts × 4,000 hours × 2d. per B.T.U.	273	6	8
	£305	8	4

The above results show that on the score of economy the balance is decidedly in favour of the metal-filament lamp. "Pam" asserts that the latter lamp is more costly than the enclosed arc lamp by nearly 30 per cent.; it would be of interest to learn whether this statement is based on results obtained from actual practice, or if it is based on theoretical assumptions only.

No photometric measurements were taken on either type of lamp, because such were not considered necessary; after all, the general effect is what the ordinary person in the street judges a lamp from, and I can only add from my own observations, that the four-light lanterns give a more pleasing effect, and a more uniform illumination, than the enclosed arc lamps. The latter give a fairly brilliant illumination in the immediate neighbourhood of the poles from which they are suspended, but outside a radius of about 100 ft. from any particular arc lamp, the street is in comparative darkness. The lanterns, on the other hand, give a more diffused light, illuminate a larger area of roadway, and throw less dense shadows; they also have the great advantage that if one lamp fails at any time during the night, the remaining three lamps continue burning, and the street is never thrown into complete darkness, as is the case when some defect in the mechanism of an arc lamp causes it to go out suddenly.

For this reason it is preferable to have four 100-C.P. lamps in one fitting, than a single 400-C.P. metal-filament lamp, which, when it fails, will cause as much temporary inconvenience as a defective arc lamp; and a further recommendation in favour of using grouped small units is that renewals are cheaper; for instance, two 400-C.P. metal-filament lamps cost £1 12s. 6d., whereas eight 100-C.P. similar lamps cost only £1 7s. 4d.; hence, on a large system the saving on renewals alone will be considerable.

About two years ago I remember seeing in Dublin, outside the town proper, some lanterns suspended from the old arc lamp poles (replacing open type arc lamps); these lanterns seemingly contained four 100-C.P. metal-filament lamps enclosed in large opalescent globes. I must confess that I was not favourably impressed with them, the indifferent effect was, no doubt, due to the use of opalescent globes. The latter are quite unnecessary for these lanterns, and, when used, cut off fully 30 per cent. of the light from the lamps; if outer globes must be used, they should be of clear glass.

I doubt if anyone has ever seen on a modern street lighting system a high-pressure gas mantle enclosed by an opalescent globe, and it seems incomprehensible if so intensely luminous a source of light can be given full licence, why any attempt should be made by means of opalescent glass, to tone down the much less intense light given from a group of comparatively small c.p. metal-filament lamps.

The merits and de-merits of medium-sized lighting units such as those under discussion have to be studied very carefully by a supply engineer who is responsible for the efficient and economical working of the public lighting system of a small town, or of suburban areas of a large town: if, therefore, as "Pam" deplores, the enclosed arc lamp is being forced out of the market by the metal-filament lamp, it is simply a case of the survival of the fittest, and shows that the consensus of opinion is in favour of the latter lamp.

The question of exterior shop lighting differs from that of street lighting only as regards the number of burning hours and the cost of energy; the comparison is, I maintain, still in favour of the metal-filament lamp. The enclosed arc is undoubtedly preferable in all cases of interior lighting, where white light is essential, and of greater importance than the question of economical running.

P. A. Spalding.

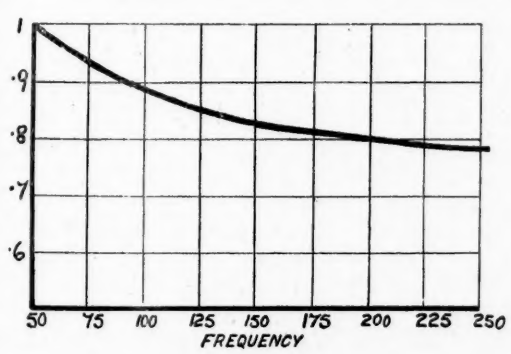
Galway, *April 7th*, 1911.

Electricity Meters.

In the paper presented to the Institution of Electrical Engineers on March 23rd, the authors bring out many points which are well worth careful consideration, especially as their conclusions are supported by carefully carried out experiments. There are, however, still some matters on which the authors invite further criticism.

On page 5 the authors say: "Shunting has the additional advantage of reducing the somewhat considerable temperature error; but errors on fluctuating loads may be introduced unless the inductances of the shunt and bath circuit are balanced."

In considering the effect of a rapidly varying load on shunted ampere-hour mercury type meters, it is necessary to divide the meters into two classes: first, those like the Ferranti (old) type where the torque is proportional to the square of the current, and second, those where the torque is proportional to the current. In the first case, if the ratio L/R in the shunt is equal to L/R in the bath circuit, the current will divide up according to their resistances, and the torque will be proportional to the square of the current in



the mains. If the fluctuations of the current are rapid, as for a motor driving a punching machine, then the speed of the meter will not have time to change as the current changes, and the meter will have a mean torque proportional to the mean of the square of the current, and as the voltage is assumed constant it will be proportional to the *root mean square current*; but the power taken from the mains is proportional to the mean current, and if the meter has been calibrated with a steady current, the meter will always register *too fast* by an amount depending on the ratio Crms/C mean, a ratio that could theoretically be very large, but in quite ordinary cases might give an error of 5 to 10 per cent. If a non-inductive shunt is put across the meter, the current from the mains divides between the two circuits, but owing to the induction in the bath circuit and series magnet, the variation of current and the ratio Crms/Cmean is less in the meter than in the shunt; but the mean current in the bath circuit is determined by the ratio of the resistances only, so the effect of putting non-inductive shunts across the meter would be to decrease any inaccuracies that might crop up owing to variations of load.

In the second class of meter, where the torque is proportional to the current, the introduction of inductance into either of the circuits will introduce no error as long as the voltage remains constant, as the current (mean) in each circuit is determined only by the ratio of resistances and the torque is proportional to the true power.

In the latter part of their paper the authors show the effect of altering the wave form of the alternator on the reading of an induction meter. These results can be easily explained.

The current flowing in an alternating-current circuit and the pressure across it at any instant can be written as follows:—

$$v = v_1 \sin(pt) + v_3 \sin(3pt + \alpha) + v_5 \sin(5pt + \beta) \ldots .$$

$$a = a_1 \sin(pt + \phi_1) + a_3 \sin(3pt + \phi_3) + a_5 \sin(5pt + \phi_5) \ldots .$$

and the mean power over a complete cycle is equal to—

$$a_1 v_1 \cos\phi_1 + v_3 a_3 \cos(\alpha - \phi_3) + v_5 a_5 \cos(\beta - \phi_5),$$

since terms involving different frequencies, when multiplied together and integrated, give zero value; therefore we get the result that the total power is the sum of the powers due to the fundamental, 3rd, 5th, 7th . . . waves, each considered separately, and if the reading of a meter is made independent of frequency it will also be independent of wave form as long as there is no appreciable change in the permeance of the magnetic circuits.

We also get the result that if only the meter reads correctly at one particular frequency, and if one of the curves is a sine wave of this frequency, it does not matter how distorted the other is, the meter will still register correctly. That is to say, if the pressure wave form of an alternating-current system is kept a sine wave, then an induction type meter can be used to register the energy on very distorted waves of current such as arc-lamp circuits, rectifiers, &c., but this is by no means true where the voltage differs from a sine wave.

It would be equally true that for a sine wave of current it would not matter how much the voltage was distorted.

In the cases the authors consider they are dealing with a non-inductive load, and the shape of the wave is the same for both current and pressure. When the harmonic is superimposed on the fundamental, the two waves, according to the above equation, could be considered quite separately as giving power to the resistance.

Reversing both current and pressure waves of either component should produce no change in the reading, since the power is not altered, and it will be seen in Table II of their paper that this is practically the case.

The reason it is not absolutely true is that the generator giving the fundamental has also a third harmonic, and this will be added vectorially to the impressed third harmonic due to the second machine and will not give quite the same value of the third harmonic when the terminals of the second machine are reversed.

It is seen that in practice the meters always read slow, and the higher the value of the harmonic in the resultant wave the slower the meters read. This is undoubtedly due to the fact that they do not register correctly the power given by the higher harmonics. The curve shown in the adjoining figure was obtained by the writer for an induction meter tested on a varying frequency at unity power factor.

It shows that a meter which was correct at its normal frequency of 50 was 15 per cent. slow at 150 ~ and 23 per cent. slow at 250 ~ and, therefore, we can tell at once, if we know the composition of any wave, how much the error in reading will be. The arrangement the authors adopted in building up their wave was to put two machines in series and to measure the voltage across each, and the voltage across the two, and the wave form of the resultant on load. It is

evident in this case that the composition of the wave cannot be judged by the voltage across each machine, since each machine will act as an inductive resistance to the current sent by the other machine and increase the readings of the voltmeters across each, but will decrease the voltage across the two. In this case the only satisfactory way to find the composition of the resultant wave is by analysis.

On analysing out wave No. 4, the writer finds the amplitude of the third harmonic about 40 per cent. of the fundamental, and the fifth harmonic about 10 per cent., and, therefore, according to the above curve the meter should read—

$$\frac{(1\cdot0)^2 + (\cdot85)\,(\cdot4)^2 + (0\cdot77)\,(\cdot1)^2}{(1\cdot0)^2 + (0\cdot4)^2 + (\cdot1)^2}$$

of the time energy, or about 2·3 per cent. slow. This gives about the same value as meter A tested by the authors.

The analysis of curve No. 5 gives the third harmonic equal in value to the fundamental, and, therefore, the meter would read—

$$\frac{(1\cdot0)^2 + 0\cdot85\,(1\cdot0)^2}{(1\cdot0)^2 + (1\cdot0)^2} = 0\cdot925$$

of true value or 7·5 per cent. too slow, which agrees again with meter A. It is inferred from these curves that meters A and B would vary with frequency in about the same way as shown in the curve above, but that meters C and D would be largely affected.

For the meter tested by the writer the current in the disk due to the current coil was displaced from the flux in the disk due to the pressure coil at normal frequency by an angle equal to the phase displacement of the current and pressure in the mains, *i.e.*, at zero power factor it did not turn, but as the frequency increased the phase displacement became larger until at 200 ~ the phase displacement was 11° and the flux in the disk was lagging behind the current in the disk.

These results explain why it is that on an inductive load the meter reads more correctly than on unity power factor, because if a large inductance is put in to make the current lag, the inductance has three times the impedance to the third harmonic that it has to the fundamental, and in addition the phase displacement is greater, so that the actual power due to the third, fifth, &c., harmonics is very small, and, therefore, the meter will register nearly correctly. The fact that the flux for the harmonics lags in the disk tends to make the meter read too fast for lagging currents, and so to compensate at some particular power factor for the reduction in flux in the disk.

If the current in the meter is leading on the pressure, the reverse holds, for not only are the harmonics in the current wave exaggerated, but the meter would not read the total power of these harmonics even at unity power factor. As the frequency increases, the flux in the disk due to the pressure coil lags more and more, and for currents leading their pressure waves by nearly 90°, the torque will be negative, and will oppose the main torque. The effect of this is very evident to distributing engineers, as they very often find that, at the sending end of a high-tension underground main, where there is a capacity current flowing in the main, the meter reads *less* than the one at the receiving end by as much as 10 per cent., and this even when the meters have been carefully calibrated beforehand.

The conclusion to be drawn is that each type of meter should be tested at frequencies much higher than those at which it is to be used, and rejected if not up to a definite standard. The standard need not be a very rigid one ; a meter as good as meter B would be quite accurate enough for any practical case, whereas meters C and D would be ruled out.

J. T. Irwin.

A Plea for the Contractor.

We read with great interest the letter of Mr. Percy Collins in this week's edition of the Electrical Review, and we thoroughly agree with him in what he says. We should like, however, to give you a case of a manufacturing firm putting in for a contract for which we were tendering. It was a provincial cinematograph theatre. We were tendering for the whole of the installation complete, and among the apparatus to be supplied was a motor-generator. We went to the people that we knew to be the cheapest for motor-generators and got a quotation. Our tender went in, and was refused. Now one of the officials of the Cinematograph Co. happened to be a friend of our director, and when asked who was the successful tenderer, he said that it was the very company whom we had asked to quote us for the motor-generator.

We do not wish to mention names, but any contractors who have done any of this work at all, will not have to think twice to know who it was.

Other instances, as a further proof of what Mr. Collins writes, could easily be obtained by reference to any back numbers of the London County Council *Gazette*, where it will be found that on several occasions the cable manufacturers have come out on top.

In conclusion, we would like, with reference to this, to give you what we consider to be one of the coolest bits of impudence imaginable. After a certain cable manufacturer had been cut out in a certain London County Council tender, they actually approached the successful tenderer, offering a lower quotation for the whole of the material for this job, than their contract prices have ever been known.

We don't know what you think, but we consider this adding insult to injury.

Michael S. Smith & Co.

London, W., *April 8th*, 1911.

LEGAL.

Sir Oliver Lodge's Wireless Telegraph Patent.

(*Concluded from page* 552.)

Continuing, Mr. Walter said he would prove that no one had ever shown tuning until Lodge's patent of 1897. By tuning, he meant that the coherer was so arranged that the period of the instrument that received should be the same as the period of the instrument that emitted the message. A simple device was used for finding out the best spark length ; a sheet of tinfoil was placed on a sheet of glass and a slit cut in the middle of it across which the spark would pass. The edges were then gradually pared off until they got the best spark. With Sir Oliver Lodge's patent they got absolutely for the first time a radiator with a definite tuning. Several people, including Marconi, had thought they had measured the period between the receiver and the transmitter, but as a matter of fact, they had only measured the period of the receiver. This was not a case where the patentee had licensed anybody or allowed anybody to infringe.

His Lordship pointed out that the mere fact that the patentee had laid by for 14 years was a reason for refusing the patent. Very great harm might be done to people who had put their money into other inventions on the assumption that this patent was not going to be worked.

Mr. Walter said that in 1906 apparatus was installed at the instance of the Indian Government, and they had tried to get the Admiralty to put up some person whom the patentee could sue for infringement; the Admiralty were using a system of their own. The applicants were also in correspondence with the Post Office authorities, but were refused leave to erect a station on the coast. To work this patent a company called the Lodge-Muirhead Wireless and General Syndicate was formed. The company was incorporated on June 29th, 1901 ; it was in the nature of a private company, and there was no public issue of shares. The capital of the company was £50,000, divided into 30,000 ordinary and 20,000 preferred shares of £1 each. Of the ordinary shares, 23,000 were issued to Dr. Muirhead, Sir Oliver Lodge and other persons who had rendered them assistance ; and of the preference shares, 13,150 were taken by Dr. Muirhead and his friends. During the first few years of the patent it was all expenditure and no receipts ; in the fifth year the company was formed and a further £1,000 spent, and the sixth year was the first giving any receipts. The accounts had been made out without allowing for the time and work of Sir Oliver and Dr. Muirhead, and they showed that during the existence of the patent £33,167 had been expended, and the receipts were less than that sum by £5,882. The patentee had been prevented from establishing a service by reason of the refusal of the Post Office to license the establishment of a station. Sir Oliver Lodge was the first inventor of wireless telegraphy, and he and those who had acted with him were out of pocket over it to the amount of nearly £6,000.

Sir Oliver Lodge gave evidence in support of his petition, and in answer to Mr. Walter, said that he had taken an interest in electric waves ever since 1871 or 1872, and in 1876 published a paper in the *Philosophical Magazine* on Maxwell's theory of electric radiation. He suggested the possibility of electromagnetic wave production as early as 1879, and Fitzgerald lectured on the subject in 1879, 1880 and 1882. Fitzgerald first wrote on the impossibility of originating wave disturbances in the ether by means of electric

forces, but the *im* was subsequently dropped out. In 1887 and 1888 Witness said he was working on the oscillating discharge of the Leyden jar, and he then found that the waves could not only be produced, but could be detected, and the wave length measured. He used wires, but the process was the same as transmission in free space, the wires merely acting as a guide. In 1889, at a lecture to the Royal Institution, he exhibited many effects of the waves in free space, but there was nothing in the nature of signalling. In 1893 he heard of Branly's filings tube, which was really an improvement on the first rough idea of a coherer, and he then developed his original coherer by using a needle point resting lightly on an aluminium plate, which was more sensitive though less manageable than a filings tube. His Royal Institution lecture in 1894 was published, and his idea there set forth was consequently unpatentable in this country, but it was patented in the United States of America. His experiments on the response between two tuned circuits made in 1890 suggested to him the means of obtaining tuning between a receiving and an emitting station, and in 1897 he filed the provisional specification of what he considered the fundamental patent in tuned or syntonic telegraphy. He then endeavoured to develop the invention with the help of Dr. Muirhead. He coined the word syntonic with the aid of two friends for the purpose of expressing what had previously been known as resonance. He also coined the word coherer to describe an arrangement for detecting electric impulses by the cohesion of two pieces of metal without effective contact until subjected to electric stimulus. Tuning was clearly in his mind at that time. Tuning between a receiver and transmitter had formed part of Hertz's plan, but no one had perceived how to do it effectually. Tuning was in his mind since 1888, but it was not until 1897 that he saw the way of applying it to telegraphy. The principal arrangement for syntonic telegraphy was a pair of capacity areas at each end sufficient to store a reasonable amount of energy and sufficiently separated to effectively emit or absorb radiation, an adjustable self-induction coil whereby the oscillations could be prolonged, and which could be adjusted for tuning, an air-gap in the emitter, closed when the arrangment was employed as a receiver, so that resonance might begin at the earliest possible moment and work up until there was an overflow through the appended coherer circuit giving a long or short response to the reception of any momentary series of waves according to the signal sent. Dr. Muirhead applied it to actuate a siphon recorder and also arranged an automatic transmitter whereby messages could be repeated after once being punched on a strip. Probably the most important item in the patent was the tuning up of the two portions of the receiver into a completely closed metallic conductor, which was a most essential feature in syntonic telegraphy. The tuning of his apparatus was remarkably accurate, especially when both capacity areas were insulated. Everything not desired could be tuned out, and yet by tight coupling other signals could be heard, even the Admiralty wave lengths.

In cross-examination, the Solicitor-General asked: Am I right in understanding that in your view the main discovery which you seek to protect by your patent of 1897 is an instrument that allows of induction coils in a system of wireless telegraphy?—Witness: Induction coils between two capacity areas. For that purpose and the mode of using it.

And the taking of the coherer out of the receiving circuit and putting it in the shunt?—That was part of the previous statement. Really it was the method of using it.

The second thing mentioned really followed from the first?—Witness would not say that

Continuing, Witness said the receiver shown in his diagram was very much like part of Marconi's 1900 invention. The Lodge-Muirhead system had been tried by the Great Eastern Railway Co. at Parkeston Quay, and it had been suggested that the system there had interfered with the Admiralty wireless station at Felixstowe. There was no interference now, though he admitted the system at Parkeston Quay had been altered. Under his system the operators could so tune as to cut out the effect of any other neighbouring system.

Evidence was given by Prof. Silvanus Thompson and Mr. Henry Muirhead, and, at the suggestion of the Solicitor-General, Mr. C. F. Wilkens, one of the managers of Muirhead & Co., Ltd., was put in the box, and cross-examined as to the Parkeston Quay installation and the complaints made with reference to it. Mr. C. J. Porter, solicitor to the syndicate, produced certain documents.

The Solicitor-General, on behalf of the Crown, said no one would think of belittling the scientific eminence of Sir Oliver Lodge or the merits of his invention, but he must point out that the inductance coil was common to Lodge and other systems of wireless telegraphy; yet no steps were taken by the applicants to restrain its use by other persons. It was difficult to see how the applicants if they got their extension would be better off than they were in the past. The fact that the petitioners had slumbered in their rights was an objection to granting the extension. There seemed to be a strong Marconi element in the system, which might lead to difficulties if the extension was granted.

Mr. Hunter Gray replied on behalf of the applicants.

Mr. Justice Parker said he was not going to prolong the life of the patent so as to enable the applicants to make money by bringing actions, but, on the other hand, he did feel that Sir Oliver Lodge deserved to make more than he had got out of the patent.

Mr. Gray said that he was quite willing to give an undertaking not to take proceedings against anybody in respect of existing installations, and it would, of course, be open to the Court to refuse injunctions in any other proceedings that might be brought.

His Lordship said that if this was a plan of making money by taking proceedings, Marconi might not be inclined to assent to it.

Mr. Gray said Marconi had had the opportunity of opposing.

Mr. Justice Parker said he must protect the public.

Mr Walter said here the Court was not protecting the public, but an individual member of the public.

His Lordship said he would reserve judgment, and would not give it before the Easter recess. In the meantime, some suggestion might be made as to the terms on which the patent might be extended.

Mr. Walter said in the meantime the applicants would submit any proposals to the Crown.

The Solicitor-General said that he was instructed there would be difficulties in the way of the Board of Trade acting as arbitrator.

Judgment was accordingly reserved.

Connolly Bros., Ltd.

In the Court of Appeal on Thursday, April 6th, the Master of the Rolls and Lords Justices Fletcher Moulton and Buckley heard an appeal by Mr. John Joseph O'Reilly from an order of Mr. Justice Parker, staying certain proceedings taken by him in the County Palatine Court of Lancaster. In an action of Wood *v.* the company, the plaintiff, suing on behalf of himself and all the other debenture-holders of the company, obtained on February 24th from Mr. Justice Parker the appointment of a Receiver. On February 20th, without communicating with the plaintiff, whose action it was suggested he must have been aware of, Mr. O'Reilly, as assignee of a mortgage on certain specific property of the company given to one Mary O'Reilly, obtained *ex parte* an appointment of a receiver of that property, and this was confirmed on February 27th. On March 8th Mr. Justice Parker made an order restraining Mr. O'Reilly from proceeding in the Palatine action on the ground that it was inconvenient to have two Receivers over the same property, and Mr. O'Reilly's rights could be properly determined in the debenture-holders' proceedings.

Mr. Grant, K.C., on behalf of Mr. O'Reilly, contended that the High Court had no jurisdiction to interfere with proceedings in the Palatine Court, but their Lordships overruled the objection and confirmed the order made by Mr. Justice Parker. In dismissing the appeal, however, they added that there was nothing in the order of the Court which would prevent Mr. O'Reilly from making an application, if necessary, for the discharge of his Receiver.

Wilson *v.* Fry.

In the Chancery Court on Friday, April 7th, Mr. Draper, on behalf of Mr. W. H. Wilson, defendant in a partnership action, applied to the Court for a committal order against the plaintiff, Mr. J. T. Fry, on the ground that plaintiff had grossly interfered with the Receiver who was appointed on the application of the defendant to take charge of the partnership assets.

Counsel stated that the parties carried on business as electrical engineers, &c., at Bromley, Kent, and the plaintiff lived at the back of the shop premises. Mr. Hicks, the Receiver appointed by the Court, informed plaintiff that he was not to go into the shop, but afterwards he had reason to believe that the papers, &c., belonging to the business were being tampered with, and he decided to put a barrier between the shop and the plaintiff's private apartments. After this was done plaintiff's son, by means of a crowbar, broke down the barrier, and in doing so smashed a glass case in the shop containing electrical appliances, and both the father and the son entered the shop, the son saying they must have their "right of way." This, defendant submitted, was a gross interference with the Receiver in his duties.

Mr. Fry, through counsel, expressed regret that the barrier should have been broken down, declaring that it was an impulsive act on his son's part. He denied that he had in any way interfered with the papers, &c., of the business, or that he wished to obstruct the Receiver in his duties.

His Lordship said that there was nothing in evidence to show that plaintiff had tampered with the papers, &c., of the business, but he was satisfied that plaintiff's action in regard to the barrier did amount to a gross interference with the Receiver in his duties, and he made an order committing Fry to prison.

Workmen's Compensation—A Gratuity.

At Manchester County Court on Friday, Judge Mellor made an award by consent in favour of the Manchester Corporation in a case under the Workmen's Compensation Act. The Corporation, however, agreed to make a gratuitous payment of £43 to the applicant, although they denied liability.

Mr. Farrington appeared for the applicant, Elizabeth Wood. He said she was the mother of a young man aged 20 years, who died December 17th, 1910, as the result of injuries sustained on December 11th, while in the employ of the Corporation. He was sent on a Sunday morning to clean a machine at the electrical sub-station at Openshaw. He was told not to touch any of the machines or switchboards without direction by an experienced man. About an hour afterwards he was found coming out enveloped in flames, and subsequently died a terrible death as the result of the injuries received. From the evidence given at the inquest, it seemed he had taken off the front of the switchboard, and had come into contact with the high-pressure terminals and sustained a severe shock. The only man who could give evidence whether the accident occurred in the course of employment was dead.

The Corporation, while denying liability, in consideration of the terrible death of the young man, decided upon an *ex gratia* payment of £43 to the mother, the applicant, and £7 costs, to which the applicant agreed.

His Honour said he thought it appeared that the man had met his death in course of employment.

Mr. Farrington said it was proved at the inquest that the deceased had no right to be near the switch, and should not have touched it unless there was a more competent man present.

His Honour: But there was a more competent man present. I have to be satisfied that this is the proper amount to pay to this woman for the loss of the support of her son.

Mr. Dehn (for the respondents): That is not quite so. This is not strictly a settlement under the Act.

His Honour: It is a gratuity?—Yes.

Mr. Farrington said he was present at the Coroner's inquiry and he recommended his Honour to approve the arrangement.

Mr. Dehn said the deceased was sent to clean a rotary converter in the sub-station which was "dead," except the switchboard. In front of that switch was a cubicle with two padlocks and four screws on it. The keys were in the telephone box, and deceased must have gone into the box and found the keys and unlocked the switch, which he had no business to do. He was probably investigating and picking up knowledge.

His Honour said he would give an award in favour of the Corporation, on the understanding that £43 was to be paid to the applicant and £7 to the solicitors for costs.

Acquisition of Telephones by the State.

In the High Courts on Friday, April 7th, before the Railway and Canal Commission (Mr. Justice A. T. Lawrence, Mr. Gathorne Hardy, and Sir J. Woodhouse). The National Telephone Co. appealed from the order of the Registrar granting the Postmaster-General leave to administer to them certain interrogatories with reference to the land, plant and buildings in various districts of the country which the company alleged the Postmaster-General had to purchase at the end of the present year when under an agreement he acquired the whole of the undertaking of the company.

Mr. Martin, K.C., with Mr. Gane appeared for the Telephone Co.; and Mr. Bransome represented the Postmaster-General.

In support of the appeal, Mr. Martin said the Postmaster-General had entered into an agreement to acquire the undertaking of the National Telephone Co. at the end of the present year, and under the agreement the Postmaster-General had the right to object to the purchase of land, plant and buildings which he considered unsuitable for the purpose of the telephone business. The Postmaster-General had given notices that he objected to the purchase of certain land, plant, and buildings, on the ground that they would not be suitable for telephone business on December 31st next. A dispute had arisen between the parties, and the Court had to decide the matter in dispute as arbitrators. The company had filed an application alleging that the notices of the Postmaster-General were not specific, and consequently not good. The case for the company was that the Postmaster-General was seeking to interpret the word "unsuitable" as meaning "unnecessary." The Registrar had given the Postmaster-General liberty to administer certain interrogatories to the company with reference to the land, plant and buildings, in a number of districts which were used wholly or partly for private business. These interrogatories placed an enormous burden on the company for no good reason, and asked for information which was irrelevant and immaterial on the present application, but which would be material when the Commissioners came to value the property of the company. At present there were 600 men at work in preparing an inventory of the property to be acquired by the Postmaster-General. They had been at work for months, and not more than 20 per cent. of the work had been done. It was estimated that it would take 15 months to complete the inventory.

Mr. Justice Lawrence: Your contention is that for the purpose of the present arbitration the information asked for would be superfluous.

Mr. Martin replied that that was so. He would be prepared before the arbitration commenced to give the Postmaster-General a list of illustrations which the company proposed to put in evidence in support of their contention that the notices were bad. These illustrations would show the Court the precise nature of the land, plant and buildings which the Postmaster-General alleged would be unsuitable for telephone purposes on December 31st next.

Mr. Justice Lawrence said that the Court was of opinion that the company should not now be called upon to answer interrogatories. The illustration which the company intended to produce at the arbitration with the object of showing that the notices were bad, would be supplied to the Postmaster-General. If during the arbitration it was shown that further information ought to be supplied by the company to the Postmaster-General, an order to that effect would be made.

Appeal allowed accordingly.

London Electric Supply Corporation, Ltd., *v.* Westminster Electric Supply Corporation, Ltd.

On Saturday last in the Chancery Division, Mr. Justice Joyce delivered his decision in this case, which was recently reported in our pages. Judgment was given dismissing the action with costs. Our report is held over until next week

PARLIAMENTARY.

Liverpool Overhead Railway Bill.

On Thursday last week the Liverpool Overhead Railway Bill came before Mr. A. Emmott's Committee of the House of Commons.

Mr. Pritchard said the Bill was promoted with three objects. The promoters desired to issue what was really a substituted debenture stock for paying off the existing terminable debentures expiring in 1913; to confirm an agreement with the Mersey Docks and Harbour Board who were willing to guarantee interest on the substituted debenture stock; and to enable the company to borrow the amount of money they were at present authorised to borrow, but without having first to raise the amount of ordinary capital which at present they were bound to raise before issuing further debentures. The company at present had £500,000 fully-paid ordinary capital and £120,000 fully-paid 5 per cent. preference capital issued under the Act of 1892.

The Chairman asked if anything was paid on the ordinary capital.

Mr. Pritchard said they did pay a little last half-year. The £10 ordinary shares of the company only stood at £2 10s. Under their Act of 1900 they were authorised to issue £60,000 second preference stock, and of this £38,600 had been issued and subscribed. The company had also borrowing powers of £226,500, and all of this had been used, except to the extent of £20,000, which could not be issued under the present powers until the entire authorised capital was issued. As their ordinary stock stood so low, it was impossible to appeal to the public for the money. With the guarantee of 4 per cent. by the Dock Board, however, they could raise the debentures at par.

Mr. Moon, K.C. (speaker's counsel), said he took it they might assume that the Docks and Harbour Board would not be given the guarantee if they thought the company could have got its capital otherwise.

Mr. Pritchard said that was so. They were simply replacing capital, and not asking for further borrowing powers than they really had now.

Answering questions by the Committee, Mr. Pritchard said the railway was originally authorised to be constructed by the Mersey Docks and Harbour Board, but they did not do it, and so the Liverpool Overhead Railway Co. was authorised to exercise the powers, and they had a lease of 999 years from the Docks Board. The railway ran right through the Dock Estate, and it was, of course, to the interest of the Docks Board that it should continue.

The Chairman asked what the actual guarantee was which the dock company was giving.

Mr. Pritchard said they guaranteed 4 per cent. interest on £226,500 debentures in perpetuity, and they had power to redeem at a certain date.

Mr. Allsopp, solicitor to the company, proved the preamble of the Bill.

The Committee ordered the Bill to go for third reading.

Nottinghamshire and Derbyshire Tramways Bill.

The Bill of the Notts. and Derby Tramways Co. came before the Unopposed Bills Committee of the House of Commons on April 6th.

Mr. Bell, for the promoters, said that the Bill was brought forward to enable the company to acquire certain lands necessary to enable them to carry out their obligations to the Nottinghamshire County Council. The scheme of tramways originally sanctioned had proved impracticable in some respects, but now, by the abandonment of certain portions sanctioned in 1908, it was hoped to be able to proceed with the scheme. An agreement had been entered into with the Nottingham Corporation by which the Corporation constructed the authorised lines of the company within the city, and the company would work them.

Mr. Holland, chairman of the company, gave evidence in support of the Bill, and said he thought the necessary capital would be forthcoming. Shares to the extent of £33,000 had already been issued amongst various friends of the company. It was the same group which was responsible for the Mansfield tramways, which were now doing fairly well.

The Committee passed the preamble of the Bill.

Widnes and Runcorn Bridge.

The Bill promoted by the Widnes Corporation for the transfer of the Widnes and Runcorn Bridge to the Widnes Corporation came before Mr. Emmott's Committee on April 6th. It is also proposed under the Bill to transfer the generating station, from which the current is generated to operate the bridge, from its present position to a site belonging to the Corporation, and the Bill contains borrowing powers to the extent of £10,000 for equipping the station and for strengthening the bridge.

Mr. Pritchard explained that it was a transporter bridge, and was owned by a few shareholders. The Widnes Corporation subscribed £25,000 and Sir John Brunner £25,000, and the Runcorn local authority also subscribed. The gross receipts from the bridge were above the working expenses, but the Widnes Corporation had to meet a yearly charge of £1,300 for repayment of loans and interest in respect of the money borrowed.

Replying to the Committee, Mr. Pritchard explained that the shareholders were giving up their property and the Widnes Corporation were acquiring a bridge which cost £130,000 for the £25,000 subscribed by them. The bridge did not produce any revenue, but it was of great value to the district.

The Committee passed the preamble of the Bill.

Northampton Corporation Tramways.

A Select Committee of the House of Commons last week considered the Bill promoted by the Northampton Corporation, which, amongst other matters, dealt with the extension of the tramway system and the adoption of the railless trolley system for one route. Mr. H. Lloyd, K.C., Mr. Vesey Knox, K.C., and Mr. B. Campion appeared for the Corporation; and Mr. Wedderburn, K.C., Mr. Talbot, K.C., and Mr. Robertson represented the London and North-Western Railway Co., who opposed certain of the tramway clauses.

Mr. Lloyd explained the objects contained in Clauses 4 and 5 of the Bill which related to street widening and the extension of the tramways to Far Cotton. This extension involved the level crossing of the London and North-Western Railway Co.'s branch line to Peterborough, and the railway company objected on the ground that the crossing of their line on the level would be a constant source of danger and would be prejudicial to the convenient working of their line.

Mr. A. Fidler, the borough engineer, was called, and expressed the opinion that the construction of a bridge to carry the tramways over the railway line would be detrimental to the surrounding property.

Mr. Wedderburn suggested to the witness that the difficulty might be got over by the tramway being constructed in two sections, one ending on the north of the railway and the other starting on the south, and that tramway passengers should walk over the level crossing.

Witness said he was opposed to such a suggestion, as it would impose considerable inconvenience on passengers.

A number of witnesses were called to prove the great demand for tramway facilities on the part of the inhabitants of Far Cotton.

Mr. Gottschalk, tramways manager, gave evidence as to the need for the tramways, and said he saw no difficulty in connection with running them over the level crossing. It was proposed to have an 8-minutes' service.

Evidence was given as to the powers of the railway company with regard to the level crossing, from which it appeared that they undoubtedly had powers to hold up the traffic.

The Chairman suggested that the parties should put their heads together and endeavour to arrive at some satisfactory arrangement.

On the resumption of the proceedings, Mr. Lloyd said his clients had communicated with the railway company, who had expressed their readiness to contribute £3,500 towards the construction of a bridge to take the place of the level crossing, but as the estimated cost of such a bridge was £25,000, the Corporation were not prepared to accept the offer.

Mr. Wedderburn argued that if the case for the Corporation were sound they would gain a greater advantage from the bridge than the company.

Mr. Stephen Sellon was called on behalf of the promoters, and gave an opinion that the proposed crossing was absolutely safe. Such crossings had been authorised since 1896, and there had never been an accident of any sort in this country.

Mr. Turnbull, general manager of the London and North-Western Railway Co., gave evidence in opposition to the proposal, and said they considered the crossing of the tramway on the level was against public safety.

Questioned by the Committee as to whether a railway company was entitled to get powers to run over a public road, and then prevent the local authority carrying traffic which might be vital to the prosperity of a district, Witness said it was really all a matter of what was necessary in the interests of public safety.

Other evidence having been called for the railway company,

The Chairman said the Committee regretted that an arrangement could not be come to between the parties for the erection of a bridge; but as this was the case, they had decided to allow the power to the Corporation to carry the tramway over the level crossing.

A number of proposed new tramways and linking up various parts of the present system were allowed, there being no opposition.

Mr. Vesey Knox said that Part 7 of the Bill asked for powers to use trolley vehicles along one route, the estimated expenditure, including cars, being £9,000. He pointed out that the Corporations of Leeds and Bradford had obtained similar powers, and would shortly commence the experiment.

Mr. Gottschalk, tramways manager, said that if they found the experiments at Leeds and Bradford were not successful, they would not, of course, go on with the scheme.

The Committee allowed the clause, subject to the conditions that trolley vehicles shall only be run with the consent of the Board of Trade, and not before January, 1913.

Croydon Railless Traction Bill.—It is intimated that the Croydon Railless Traction Bill will not be proceeded with. The proposal was to incorporate a company with a capital of £60,000 construct a system in Purley, Beddington and district

Electricity and Agriculture.—In Friday's Parliamentary Papers Mr. Geo. Roberts asked the Parliamentary Secretary to the Board of Agriculture, if the Department had made or caused to be made any experiments in electrical stimulation; and, if so, could he state where such experiments had been conducted, with what crops, at what cost, and with what results. Sir E. Strachey said that experiments of the kind were carried out by the University of Bristol, to whom a grant of £50 was made by the Board in aid of the expenses. A report on the subject was published in the Board's *Journal* for April, 1910. Mr. Bathurst also asked whether, in view of the value of the researches and experiments of Prof. Priestley, of Bristol University, and others, as showing the effect of the discharge of positive electricity on the development and the acceleration of growth of plants, the Board would either increase their present grant of £50 for the advancement of this work, or apply for a grant out of the Development Fund for this purpose. Sir E. Strachey said the Board anticipated that under a general scheme for the promotion of agricultural research, which was now under the consideration of the Development Commissioners, funds would be available before long for investigations of the character suggested.

Aberdare and District Tramways.—The Bill promoted by the Aberdare Urban District Council for the construction of tramways in the district came, on April 6th, before the Standing Orders Committee of the House of Lords.—Mr. Baker (Parliamentary agent) explained that the appearance was in connection with the alteration of plans for a bridge across the river at Cwmbach, which, it was hoped, would lead to the withdrawal of a good deal of opposition.—There being no opposition, the Bill was reported for Second Reading.

BUSINESS NOTES.

Book Notices.—*North of England Coal, Steel and Iron Industries.* Newcastle-on-Tyne: Wise, Speke & Co., stock and share brokers.—This little book gives in the course of 96 pages particulars of the capital, and other financial and general information regarding 20 of the principal firms connected with the coal, iron and steel industries in that part of the country.

We have received the 1908-10 Supplement to the Catalogue of Lewis's Medical and Scientific Circulating Library, 136, Gower Street, W.C., price 6d. (free to subscribers). It is a catalogue of authors' names, but by means of an index of subjects, in which references to the authors' names are given, its utility is greatly extended. About 2,000 works are included in the supplement, a considerable proportion of which relate to engineering matters.

The Tramways and Light Railways Association's *Journal* for April contains a report on "Speed Indicators," drawn up at the suggestion of the Board of Trade. The members of the Special Committee signing the report are the following.—Messrs. A. H. Pott, R. W. Cramp, H. England, W. E. Ireland, C. W. Mallins and S. Sellon. The *Journal* is a "special" number, copies of which can be obtained by non-members at 2s. 6d. each. The report is fully illustrated, and covers 43 pages. The Annual Congress of the Association will be held at Edinburgh on July 13th and 14th next.

Messrs. Constable & Co. are issuing a series of "Electric Installation Manuals; by Practical Men for Practical Men." The prices will range from 1s. net to 2s. net. The first two volumes to appear are noted below, and will be followed at a short interval by others, amongst which will be "Electric Mining Installations," "Mill and Factory Wiring," "Ship Wiring and Fitting," "Bells, Telephones," &c.

"Motors, Secondary Batteries, Measuring Instruments and Switchgear." By S. Kenneth Broadfoot. "Arc Lamps and Accessory Apparatus." By J. H. Johnson: London: Constable and Co. Price 1s. net.

"The Motor Cyclist's Handbook." 1911. London: Percival Marshall & Co. Price 2s. net.

"The Evolution of the Parsons Steam Turbine." By Alex. Richardson. 1911. London: Offices of *Engineering*. Price 21s.

"Boletin de Ingenieros." Vol. I, No. 7. March, 1911. Mexico: Secretaria de Guerray, Marina.

"Bulletin Scientifique de l'Association des Elèves des Ecoles Speciales." April, 1911. Liége: *Imprimerie Moderne*. Price 75 c.

Meter Contracts.—Belfast, Barrow and West Hartlepool Corporations have again accepted the tenders of Messrs. Venner and Co. for Chamberlain & Hookham meters for the ensuing 12 months. Belfast has also accepted their tender for "Venner" time switches.

The O.S. Wiring System. — The new Examination Offices at the Carriage Department, New Scotland Yard, have recently been wired throughout on the O.S. wiring system by Messrs. Rawlings Bros., Ltd., in accordance with the specification of the Police Surveyor.

Japan.—The manager of the Imperial Hotel, Ltd., is reported to be developing a scheme for a 250-room hotel at Tokio, to cost £200,000. The equipment will be on quite modern lines. More hotels, it is said, will have to be provided, especially in readiness for the 1917 Exposition. Foreigners who visit Tokio in increasing numbers on business bent would, it is thought, spend more time in Japan if they had "a home" to go to, and the presen hotel scheme is intended to meet that want.

"Cheap."—An American Consular officer in the Far East reports that a trading company in his district desires to purchase electrical accessories of all varieties from manufacturers in the United States. "Goods intended for this market must be cheap to compete with similar goods of British and German manufacture."

Stoker Contracts.—In the list of orders booked during March by the Underfeed Stoker Co., Ltd., are the following:—

Calcutta Electric Supply Co., of Cossipore	8 "E."
State Coal Co., Australia	16 B5
Brompton and Kensington Electric Supply Co. ..	8 "D."

Social Evening.—The employés of Messrs. Elliott Bros., of Century Works, Lewisham, S.E., held a very successful social evening at the Blackheath Concert Hall on Saturday, April 1st. The hall was filled to its utmost capacity, and a very enjoyable evening was spent. A number of local residents kindly gave their services for the entertainment, which consisted of the "Pom-Pom" Pierrots during the first half of the evening, this being followed by the well-known farce, in three acts, entitled "Facing the Music." The music rendered by the Century Works Orchestra added greatly to the enjoyment of the evening.

Manufacturing in Italy.—The annual report of the A.E.G.-Thomson-Houston, Società Italiana di Elettricità, of Milan, states that notwithstanding the crisis still prevailing in certain industries, the company experienced a larger turnover in 1910 than in the preceding year, although the large orders could only be obtained at low prices. The gross profits increased, but the higher wages which had to be paid, advanced in a greater degree than the profits, and after providing £6,000 for depreciation, as in 1909, the accounts show net profits of £19,380, as compared with £23,000 in the preceding year. As it is proposed to pay a dividend of 6 per cent. for 1910, as in the previous year, the amount to be carried forward becomes reduced from £6,200 in 1909, to £2,900 last year. The report mentions that manufacturing in the company's new works in Milan was fully embarked upon during the year, and the establishment was well employed and finds occupation for 400 workers. Numerous orders were received by the traction department, and at the present time 72 miles of railway and tramway are in course of construction, with cars representing 11,000 H.P. The share capital of the company amounts to £360,000, and the reserve funds stands at £13,000.

Bankruptcy Proceedings.—Mr. Thomas White.—At a sitting of the London Bankruptcy Court, held on Tuesday last week before Mr. Registrar Linklater, the debtor presented himself for public examination upon accounts showing total liabilities £13,059 and a deficiency estimated at £12,109. In the course of his examination by Mr. Egerton S. Grey, Official Receiver, he stated that in 1893 he executed a deed of partnership with two other persons, who were then trading as electrical engineers in Berners Street, W., under which he brought in £3.000, a loan from his wife, and acquired a third share in their business. He had for some years previously been a director of a limited liability company carrying on business as music publishers on adjacent premises. Witness controlled both businesses until 1898 when the partnership expired by effluxion of time. He and his former partners then formed the electrical engineers' business into a limited liability company, under the style of Frank Suter & Co., Ltd., to which the assets of the former partnership were assigned in consideration of £15,000, payable in shares, and the appointment of witness and his former partners as managing directors at a remuneration of £300 per annum each. The company failed in 1908, with the result that he was saddled with liabilities amounting to upwards of £4,500 in respect of guarantees given by him on the company's behalf. Witness attributed his insolvency to liabilities he incurred under the guarantees given on behalf of the before-mentioned companies. He estimated his loss in connection with the liquidation of Frank Suter & Co., Ltd., at £1,430. The examination was concluded.

Dissolutions and Liquidations.—Connolly Bros., Ltd., Vale Mills, Blackley, Manchester.—Mr. J. M. Henderson, the Receiver and Manager, has issued the following approximate statement of the financial position of this company at February 24th, 1911:—*Liabilities:* Debentures—First, £29,550; second, £5,000 = £34,550; debenture interest to February 24th, 1911, £220. Creditors: Open accounts, £17,241; loans, £1,867 (mortgage for £1,000 on Factory Lane property to secure part of above loans, but at present this charge is under consideration by the Court); share capital, £19,710 = £73,589. *Assets:* Freehold premises, plant, machinery and fixtures, as per E. Rushton, Son & Kenyon's valuation (including the Factory Lane premises), £33,294; loose tools, utensils, office furniture, drums, &c. (not included in above valuation), £9,036; stock-in-trade at cost or current price (whichever is lower), £16,682; patents, amount expended, £7,000; book debts (£6,750), say £6,000; deficiency, £1,577 = £73,587.

Allan Electrical Syndicate, Ltd.—A meeting is to be held at 3, London Wall Buildings, E.C., on May 11th, to hear an account of the winding up from the liquidator, Mr. H. Garton Ash.

Lindsay & Co., electrical and mechanical engineers, Crown Works, 78, Lees Road, Oldham.—Messrs. J. Bullivant & J. Lindsay have dissolved partnership.

Phosphor Bronze Co., Ltd., 87, Sumner Street, Southwark, S.E.—A second and final return to contributories of 2s. 1½d. per share was payable on April 10th at the offices of the liquidator, 8, Frederick's Place, Old Jewry, E.C.

Trade Announcements. — Messrs. S. Thomas Pemberton & Co., of 8, Church Street, Colmore Row, Birmingham, have been appointed the representatives in the Midland Counties for Messrs. T. Harding Churton's A.C. motors

The Midland Electrical Manufacturing Co., Ltd., announce that owing to the growth of their business, they are removing their factory to new premises, viz:—Stafford Works, Rea Street South, Birmingham. Owing to this the works will be closed from April 13th—22nd inclusive, as regards reception of goods.

For Sale.—The Halifax Corporation Electricity Committee have for sale a 300-KW., three-phase, 25-cycle alternator, coupled to a horizontal slow speed, cross-compound engine. See our advertisement pages in this issue.

France.—La Société Le Watt Electrique is the name of a new company which has lately been formed in Paris (31, Rue Daru), with a capital of £40,000, to manufacture electric heating plant and apparatus.

Catalogues and Lists.—Messrs. S. Thomas Pemberton and Co., 8, Church Street, Colmore Row, Birmingham.—Desk calendar, with let-in monthly slips.

The Century Electric Co., St. Louis, U.S.A.—16-page bulletin describing with numerous illustrations and prices, weights, code words, &c., their various A.C. fan motors and fans.

Messrs. Heathman & Co., Parson's Green, Fulham, S.W.—New illustrated price list of platform steps, telescopic and ordinary ladders, fire escapes and other similar lines.

Messrs. Boulton & Paul, Ltd., Norwich.—Forty-two page catalogue (art paper) giving full information regarding their petrol and paraffin engines for electric lighting, marine and industrial purposes with prices of same for home and for export supply. Some notes on the use of combined electric lighting sets for private bungalows and residences are followed with a specification of these engines and generators for 50, 100, 200, 300, and 600 16-C.P. lamps. The "Norvic" patent petrol-gas plant and its working are also described, shipping particulars being given. These plants are, of course, British-made, and any reader can obtain a copy of the list on application.

Messrs. Krupka & Jacoby, 11, Queen Victoria Street, London, E.C.—A number of illustrated price lists of Siemens flame arc lamp carbons, rubber cables, &c.

The Sterling Telephone and Electric Co., Ltd., 200, Upper Thames Street, London, E.C.—Pocket pamphlet No. 182, consisting of 48 pages of illustrations, brief descriptions and prices of their various "Sterling" telephone instruments and accessories.

LIGHTING and POWER NOTES.

Ashton-under-Lyne.—It has been decided to extend the electricity works by entirely remodelling them at an expenditure of £30,000. The new plant is required to meet many new demands, several large firms having expressed willingness to establish works in the borough if electric power can be had at a cheap rate, and it is to make a bid for this extra custom that the Council on the 12th inst. was to be asked to give support to the extension scheme.

Bradford.—The Electricity Committee has under consideration the question of installing at the electricity works in Valley Road a third 3,000-KW. turbo-generator, together with switchgear, &c., at an estimated cost of about £20,000.

Bury.—The scheme of electrical extensions for which the L.G.B. has just sanctioned loans amounting to £72,170, is making (under Mr. S. J. Watson, borough electrical engineer) steady progress, and the new generating station, it is hoped, will be completed in the course of a couple of months. The principal plant installed consists of two 2,000-KW. turbo-alternators, the turbines being of the Zoelly type manufactured by Messrs. J. Musgrave & Sons, Bolton, and the alternators made by Messrs. Siemens Bros. There will be three boilers of the Woodeson type, supplied by Messrs. Clarke, Chapman, each capable of evaporating 25,000 lb. of water per hour.

Canada.—The City of Edmonton has been offered by the Dominion Government the right to develop water power at Grand Rapids on the Athabasca River. The agreement forwarded by the Minister of the Interior stipulates, *inter alia*, that actual construction operations be commenced on or before January 1st, 1912, and that the city expend $100,000 in 1912, and the same sum during the years 1913, 1914 and 1915, unless 10,000 H.P. has been already developed. The city must also proceed to develop the power to a maximum capacity of 60,000 H.P. at any time after January 1st, 1916, should the Minister consider it necessary or advisable. The city, if called upon, had to declare its intention of rejecting or accepting this agreement before April 3rd.—*Commercial Intelligence.*

Carnarvon.—The electric light is to be permanently installed at the Castle in time for the investiture of the Prince of Wales. The work will be done and current supplied by the Car-

narvon Electric Works. The well at the Castle has been pumped dry by means of an electric pump, after the fire brigade had failed to lower the water.

Derby.—The Electric Lighting Committee presented a report to the T.C. on April 5th dealing with a proposed extension of electric power facilities in the Osmaston district. The present supply represents a yearly revenue of £2,500, and with orders in hand the total revenue in two or three years' time is estimated at £7,000. In place of single-phase supply the Committee recommended a three-phase supply at a pressure of about 6,500 volts. To carry out the extension it was proposed to borrow £6,650.—When the chairman of the Committee (Alderman Butterworth) moved that authority be given to carry out the work, Alderman Hart asked whether it was proposed to meet the cost out of the revenue of the electricity department, as the outstanding electrical expenditure was £220,000. He moved that before the recommendations were agreed to, more information should be supplied.—Alderman Butterworth protested against not having been allowed to go into details when moving the resolution.—The Mayor declared that he had not acted unfairly.—Eventually Alderman Butterworth was allowed to assure the Council that no existing machinery would be superseded by the extension.—The Committee's recommendations were then adopted.

East Kent.—The East Kent Electric Power Co., Ltd., is applying to Parliament for the transfer to it of certain powers possessed by the Kent Electric Power Co. under the Kent Electric Power Acts, 1902 and 1906. The area to which the powers sought apply stretches from Swalecliffe to the boundaries of the Isle of Thanet, Hythe, Cheriton, Folkestone, Dover and Canterbury, and includes that part of Kent in which coal borings are being carried out. The application also seeks power to extend the area from time to time, and to erect generating stations and distribute electrical power

Epsom.—The U.D.C. has decided to supply energy for lighting to all hotels at 3½d. per unit. For Coronation illuminations private residents are to be supplied at the rate of ½d. per 8-C.P. lamp per evening.

Haddington.—At a meeting of the Western District Committee of the C.C. a proposal was considered of Messrs. Crompton & Co., electrical contractors, to introduce electric light into Gullane. It was stated that the company had entered into an agreement with North Berwick T.C. for the introduction of electric light into that burgh, and the Committee was asked if it would favourably consider a similar scheme for Gullane. The question was remitted to a sub-Committee.

Hastings.—The T.C. has applied to the L.G.B. for a loan of £649 10s. for mains extensions.

Lincoln.—At a meeting of the City Council on April 4th, Mr. W. S. White moved the adoption of the Electricity Works Committee's minutes. He said it had considered the question of extending the tramway system from east to west, as suggested by Mr. Kilmister, and decided that it was not opportune to make the extension until the water question was out of the way. The Committee had resolved to devote £2,000 from the electricity department to the relief of the rates. In 1908 the Committee allocated £1,000 to the same purpose. The Council confirmed the minutes.

Liverpool.—At the City Council last week, it was resolved that as from the end of the June quarter the restriction limiting the maximum demand system of charging for electrical energy for lighting purposes to consumers guaranteeing to take not less than 100,000 units per annum be withdrawn, and that the rateable value system of charging be continued for private purposes on the terms at present in force, and offered as an alternative method of charging to all other consumers on the basis of a fixed charge per annum of 18 per cent. on the rateable value of the premises and 1d. per unit for each unit metered, this arrangement to be applicable only to the premises rated on the ordinary basis, and not to be available for charitable or religious institutions, or for any other consumers having special concessions as to assessment of rates.

Leeds.—The electricity department having come to the conclusion that the advantageous use of the maximum demand system of charging power users is to some extent ceasing, owing to the developed state of power supply in the city—the total power demand being 15,000 H.P.—it has been decided to suspend it partially with a view to giving everyone a power supply at a price not exceeding the lowest price now charged (·9d. per unit). For all motors of over ¼ total H.P. the charges will now range from 1½d. per unit in any quarter when the units are less than 450 per KW. maximum load, down to ·9d., when the units similarly are 1,000 or upwards. In addition, rebates depending on quantity used are offered, these providing that when the units per quarter are 3,000 or more the price shall not exceed 1¾d. per unit, and ranging in stages up to 400,000 units or upwards a quarter, when the price is ·75d. per unit. The revenue on its present supply is expected to fall £2,350 per annum, but it appears that the revision is more of a necessity than a virtue, as it is mentioned that one large firm alone which might withdraw if the prices remained unaltered, would in that event deprive the department of a much larger sum. The price of energy for heating is also to be reduced from 1½d. to 1d. per unit.

The tramways and electric supply departments have come to an arrangement for converting the tramways department generating and other plant from its present periodicity, 25 cycles, to 50 cycles, so that mutual assistance may be given. It is understood that the electricity department will otherwise have to extend its generating plant shortly.

Loughborough.—The question of electric street lighting has been up again before the Council, on an amendment to its recent decision to adhere to gas lighting, when the voting was very close. The voting on the amendment was equally close, 10 being in favour and 11 against.

Oulton Broad.—The Council has adopted a report favouring an agreement with the East Anglian Ice Co., which has offered to supply between 10,000 and 30,000 units per annum at 2½d. per unit, metered at its works. The Council will have to spend up to £2,500 on feeders and distribution in its area.

Lowestoft.—The town clerk has been directed to apply to the L.G.B. for sanction to the borrowing by the Town Council of a loan of £3,000 for new mains for electric lighting purposes.

Portishead.—At the D.C. meeting an application by Messrs. Christie Bros. that a prov. order be granted them by the B. of T. for the lighting of Portishead and adjacent parishes by electric light was considered. It was stated that the matter was fully discussed at a meeting of the C.C., and it was decided to oppose the scheme unless Messrs. Christie Bros. agreed to make considerable alteration in it. They wanted powers to supply the whole district, and yet be only compelled to light Portishead and Easton-in-Gordano, and so the C.C. decided to oppose until it had got proper terms. The D.C. decided to do the same.

Rawtenstall.—The T.C. has decided to apply to the L.G.B. for sanction to borrow the sum of £15,000 in connection with the electricity undertaking.

Rochdale.—The Electricity Committee has decided to recommend that the manager prepare estimates and plans for a further chimney stack, flues and economisers, also an extension of the engine room plant and the installation of switchgear there, and further boilers for the existing boiler house and modification of the alternating current switchgear and feeder cables.

St. Helens.—Last week the Mayor started a new 1,000-KW. turbo-alternator and other new plant at the electricity works. The machine generates electricity at a pressure of 6,600 volts. At the conclusion of the ceremony the councillors were taken over the power station.

Sandwich, Deal and Walmer.—In consequence of the opposition of the Kent Power Co., the Sandwich, Deal and Walmer E.L. Co. has amended the prov. order for E.L., limiting the area of supply to the three towns named, and excluding the rural districts *en route*. The company proposes to obtain current in bulk from the Dover T.C.

South Africa.—A report of the Johannesburg Finance Committee, quoted by the *Board of Trade Journal*, gives municipal estimates for the five years, 1911-15, which include £289,680 for electric power and lighting, and £298,236 for tramway purposes.

Southborough.—With reference to the demand of the U.D.C. for a 5 per cent. share of the amount to be paid by probable consumers of current to Tunbridge Wells T.C., for the privilege of the latter body supplying in its area, the L.G.B. has intimated that unless the condition is withdrawn, it was prepared to hold that the consent of the U.D.C. had been unreasonably withheld.

South Shields.—At a meeting of the T.C. on the 5th inst., the Works Sub-Committee of the Electricity Committee submitted a new scheme of extensions in lieu of that which formed the subject of an inquiry by the L.G.B. recently, which inquiry, it will be remembered, was adjourned *sine die*. The Sub-Committee stated that in consequence of certain matters arising out of that inquiry, it instructed the borough electrical engineer to devise an amended scheme for extending the plant, and his report and scheme had been submitted to Mr. J. F. C. Snell, who had endorsed it. The Sub-Committee now recommend the following scheme:—"One 1,500-KW. capacity turbine coupled direct to one 1,000-KW. D.C. generator, and one 1,100-KW. A.C. generator, £8,350; pipe work, £200; switchboard, £200; foundations, £250; motor-driven circulating pump, pipe work, and foundations, &c., £600; a total of £9,600. Contingencies were put down at £480, making the grand total £10,080. In order that this plant may be installed, it will be necessary to remove two 100-KW. reciprocating sets for A.C. upon which the capital loan account still undischarged is approximately £2,500. This scheme will, however, obviate the necessity of extending the buildings. (2) That application be made to the L.G.B. for sanction to the borrowing by the Council of the sum of £7,580. (3) That the balance of the cost of the scheme, viz.:—£2,500 be taken out of the reserve fund. (4) That the electrical engineer be instructed to prepare plans and specifications for carrying out the foregoing scheme, and that tenders be obtained for the carrying out of the work." The report recommends the rescinding of the Council's resolutions in regard to the former scheme, and having been confirmed by the Electricity Committee, was adopted by the T.C.

Stockport.—The T.C. has decided not to proceed at present with the proposed supply of alternating current.

Woodbridge.—Mr. E. Charrington and Mr. Owen, of Messrs. Foote & Milne, attended a meeting of the U.D.C. on April 4th, and explained a scheme of E.L. for the town by means of

overhead mains. The Council appointed a Committee to go thoroughly into the matter.

Worcester.—The chairman of the Finance Committee (Alderman Millington), in presenting the estimates for the year, and referring to the electricity undertaking, said it was useless for the Committee to go on as they had been going for so long. In round figures, the capital of the undertaking was £140,000. They were all bound to admit that it was over-capitalised. Something must be done to help the Committee, and he proposed to take off £50,000 of that capital, and put it into a special suspense account. That would relieve the Committee of the payment of £3,000 a year. With that the Committee ought to show a handsome profit, and the profit would go towards wiping out that suspense account. In addition, he proposed to ask the Council to give the Committee the benefit of the £10,000 stock it had just redeemed, in addition to the £5,000 worth recently bought. If the Committee did not make the works a success then, it would never do so. The suggestion to write off capital was cordially welcomed by those who have taken an active part in the management of the undertaking, and the matter was referred to the Finance Committee to report as to how the arrangement could be effected.

Worthing.—Instead of a debit balance of £125 as estimated six months ago, the electric lighting revenue account submitted to the T.C. in connection with the half-yearly "Budget," showed a small balance on the right side of £8, and an approximate estimate for the coming 12 months pointed to an estimated credit balance on March 31st, 1912, of £173. This satisfactory state of things has been reached after an expenditure of 50 guineas for an expert advice on a matter which has recently been before the Committee.

TRAMWAY and RAILWAY NOTES.

Bath.—The Council was occupied for some time at a recent meeting in considering the refusal of the Sanitary Committee to grant licences for motor-omnibuses to the Bristol Tramways and Carriage Co. One of the speakers said he understood the Tramways Co. some years ago made a bargain with the Council to run tramways, and an agreement was arrived at after consideration, a money value was put upon it and the agreement was conclusive. If, however, that was going to act as a precedent, a monopoly would be created, and that was a principle which was bad and ought not to be adopted by the Council. When the agreement was made with the Bath Tramway Co., it was for the monopoly of running tramcars, and tramcars only. Now the monopoly had been extended to other forms of conveyance. He admitted that it was extremely hard that the company should have to spend money on lines and widening the streets, but this was part of the arrangement, therefore it could not be urged that the company had given the Council a present, when it was part of the contract. Another member, who had advocated in committee the granting of the licences, said since then he had had some conversation with the managers of the Bristol Tramways Co. and the Bath Tramway Co., and he was bound to change sides. The Bath Tramway Co. made a bargain with the city, and he looked upon it as incumbent on the city to fulfil its side of the bargain. He reminded the Corporation that the Electric Tramway Co. gave to the city the sum of £16,400 for the right of running cars, the greater part of which was spent in the improvement of Bath, and if it accepted that sum from the Tramway Co., it had to give the company a *quid pro quo*. In addition, the Tramway Co. had expended a sum of £10,000 towards the upkeep of the roads. The company had given the city a very fine service indeed, and an equally fine service of motor-omnibuses. A further point urged in favour of the Tramway Co. was that a new bridge over the river had been entirely paid for by the company to facilitate the running of the trams. In the end, an amendment to refer the matter back was lost by 33 votes to 9.

Blackpool.—The T.C. has decided to apply to the L.G.B. for a further loan of £2,000 for the equipment of additional cars with top-deck covers.

Continental Notes.—Germany.—A concession has just been secured by the A.E.G., of Berlin, for the construction and working of an electric railway between Merseburg and Mucheln, a distance of about 12 miles.

Spain.—The Société des Tramways de Barcelone, San-Andres, et Extensions has secured a concession for the construction and working during a period of 60 years of an electric tramway between Barcelona and Gracia.

Halifax.—The income of the tramways undertaking for the past year has been £92,609; expenditure, £81,109; profit, £11,500, against £13,065 last year. The expenditure on the electric current has been £2,412 more than in the previous year, and the track has cost £1,645 more. The tramways yielded £5,500 in relief of the rates, and the reserve fund now stands at £7,360.

The Corporation has given notice of its intention to apply for leave to introduce in the Halifax Corporation Bill now pending in Parliament, provisions giving power among other things to construct a tramway along Northgate and Park Street.

Java.—The *Bulletin Commercial* (Brussels) of April 1st notifies, on the authority of the Belgian Consul at Batavia, that a European, representing a group of Chinese capitalists, has applied to the Government of the Netherlands East Indies for a concession for the construction and working of electric tramways in Batavia. It is estimated that four years will be required to carry out the work.—*Board of Trade Journal.*

London.—According to the *Standard*, the work on the Central London Railway extension from the Bank to Liverpool Street is now in full swing. The operations are being carried out from a shaft in Bishopsgate Street, and work is now in progress with the 22-ft. shield under Liverpool Street Station, where the future tube station will be situated. The distance from the latter to the Bank is only ½ mile, which is estimated to cost £250,000, and to be completed in about 18 months' time.

Nelson.—At a meeting of the Nelson T.C. on Wednesday, last week, it was resolved that the offer of the Burnley Corporation, which was based upon the principle of a division of profits, be accepted, and that an agreement be entered into for leasing and working of the Nelson section for a period of 14 years upon the following terms: The rent to be £692 per annum; electricity to be supplied by Nelson at 2d. per B. of T. unit, and Nelson Corporation to maintain the road and track in consideration of a fixed annual payment of £150; Burnley to maintain the overhead equipment.

Motherwell.—In connection with an extension by the Lanarkshire Tramway Co. from Merry Street to New Stevenston, a new steel bridge, estimated to cost £7,000, is to be erected over the River Calder. The cost will be defrayed by the company and the T.C.

Morecambe.—It is reported that the profits on the tramways undertaking for the year ended March 31st amount to nearly £1,500, an increase of about £800 on last year's figures.

Rochdale.—The gross receipts of the tramways department for the year ended March 31st, were £63,041, against £57,889, these amounts including the takings on the Heywood length. On the Rochdale system the total was £58,730, an increase of £4,662. Deducting the Whitworth receipts, the gross takings show an increase of £972, which, considering the bad weather, was not unsatisfactory.

The tramways manager was instructed to prepare specifications for the construction of the Milnrow tramway, with a view to the work being commenced as early as possible.

South Shields.—At a meeting of the T.C. on the 5th inst., the Tramways Committee recommended the Council not to insure against third party risks for a period of 12 months ending March 31st, 1912; that the tramway manager settle claims up to £5 in each case; and that the chairman, vice-chairman, and the manager settle claims up to £15 in each case, and the Committee deal with and settle beyond this amount. It was mentioned that the premiums paid had always more than met liabilities, and it considered the offers it had received were prohibitive. The last premium was at the rate of £315 per annum. While it had spent £1,700 in third party insurance it had probably cost the companies no more than the odd £700. The recommendations were carried.

The Tramways Committee also recommended that unless the Jarrow and District Electric Traction Co. was prepared to accept a reduction in the amount paid to it by the Corporation from 3·6d. per car-mile to 3·25d., one month's notice be given to the company to terminate the agreement between the Corporation and the company. Alderman Wylie, in moving the adoption of the report, said that the figure adopted was taken as an experiment. Mr. Henderson seconded the report, and replying to a question, said it was true that the Jarrow cars carried 17,000, but only 5,000 of that number were Jarrow passengers. The sum total of it was that the T.C. was paying the Jarrow Co. £140 more than it ought to pay.—Mr. Dunlop spoke of the great advantages to the working classes of the through service. He moved that the matter go back to Committee, but after discussion the report was agreed to.

Wigan.—At the T.C. meeting last week, Alderman Ashton, reviewing the history of the tramways undertaking, said that whilst they were supposed to be contributing to the rates to the extent of £6,534, they had against them, owing to the bank, on tramway revenue an account for £13,000. Although £100,000 had been paid, they had prospectively this year a further loss of £8,000 to £8,300. An amendment advocating the increase of tramway employés' wages was defeated by 36 votes to 7. Councillor Cheetham said the men got 6d. per hour for 65 hours per week, and were not paid in proportion to other towns.

TELEGRAPH and TELEPHONE NOTES.

Italy.—The estimate of expenditure on new telephones for the year 1910-11 is fixed at 5,260,000 lire. Since the installation of telephones in Italy, 60,792,186 lire have been voted for the telephone service, of which all but 9,200,215 lire have been spent. From official statistics just issued, it appears that in 1910 there were 46,293 subscribers to the State system, and 20,170 subscribers to private telephone companies; the State exchanges numbered 377, and those of private companies 671; the State interurban network

had an extension of 22,838 km., private interurban lines were 3,704 km. in extent, and international lines 739 km. In the same year the interurban calls were 2,880,358 on the State system, and 1,511,252 on those of private companies. International calls were: with France, 97,469; with Switzerland, 72,884; and with Austria, 2,833. The relative fewness of the calls with the last-named country is owing to the fact that the installation had only been working two months and 18 days.—*Giornale dei Lavori pubblici.*

Telegraphists' Conference.—At the annual conference of the Postal Telegraph Clerks' Association, held at Nottingham last week, a resolution was passed condemning the Postmaster-General for not receiving a deputation on the subject of wages, and requesting him to receive it at once. The Conference rejected a resolution to the effect that the relations of the Association to the Labour Party be reviewed, and decided to request the latter—with which it is affiliated—to assist it in inducing the P.M.G. to receive a deputation.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—May 8th. Battery of accumulators, with boosters and switchboards, for the Melbourne City Council. See "Official Notices" February 24th.

April 21st.—120 5-ampere 200-volt A.C. watt-hour meters, for the Melbourne City Council. See "Official Notices" to-day.

May 16th.—10,000 telephone protectors, for the P.M.G.'s Department in Victoria. See "Official Notices" March 31st.

May 30th.—One portable petrol-driven desiccating plant, for the P.M.G.'s Department in Victoria. See "Official Notices" April 7th.

May 31st.—7,000 insulators and wire and line material, for the P.M.G.'s Department in South Australia. See "Official Notices" April 7th.

June 14th.—Switchboard, common-battery, multiple, for the P.M.G.'s Department in South Australia. See "Official Notices" February 3rd.

June 14th.—Branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

July 25th.—Deputy-P.M.G., Melbourne. Twelve sections of a branching multiple magneto lamp signalling switchboard, &c., or one automatic or semi-automatic switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" March 24th.

Austria.—April 28th. The Austrian State Railway authorities at Prague are inviting tenders for the contract for installations of electric lighting at the railway stations at Eisenberg and Obergeorgenthal.

Belgium.—April 24th. The Provincial Government authorities at Mons are inviting tenders for the concession for the construction and working of an electric tramway between Charleroi and Couillet-Queue.

Bulgaria.—April 19th. Tenders are invited for the supply of Varna with electric light. Specifications 30 francs, from the "Burgermeisteramt der Stadt Varna," Varna. Deposit £2,000. A copy, in Bulgarian, may be seen at the Board of Trade C.I. Branch in London.

Bury.—April 21st. Wiring and fitting for the electric lighting of the Chamber Hall Power Station, for the Corporation. See "Official Notices" April 7th.

Derby.—Inverted rotary converters, E.H.T. cables and E.H.T. switchgear, for the Borough Electricity Department. See "Official Notices" April 7th.

Dudley.—April 19th. Stores for a year, for the Corporation Electricity Department. See "Official Notices" April 7th.

Eccles.—In compliance with the regulations of the Home Office, five generator and feeder panels and synchronising gear are to be provided at the generating station. Tenders are to be invited for these.

Edinburgh.—April 17th. Cast-iron pipe work for condensing water, &c., for the Corporation Electricity Supply. See "Official Notices" April 7th.

Egham.—April 24th. Two high-speed Diesel oil engines, coupled to 100-KW. single-phase alternators, with exciters, piping, &c.; one 4-ton overhead traveller, and main high-tension switchboard, for the Egham and District Electric Lighting Co., Ltd. See "Official Notices" April 7th

Glasgow.—April 24th. Steam turbo-alternator, with condensing plant, for the Corporation tramways See "Official Notices" March 17th

Hornsey.—April 24th. Flame arc lamps, for the T.C. See "Official Notices" March 31st.

London.—300 D.C. and A.C. meters and 500 interlocked ironclad fuse-switches or ironclad switches connected to double-pole ironclad cartridge fuses, sizes from 15 to 250 amps., for the Committee of the Electrical Exhibition, Olympia. See "Official Notices" March 31st.

L.C.C.—Tenders are to be invited for four car-traversers at carsheds, also for the erection of a workshop, store, &c., at the Stockwell sub-station; also for two motor cars for the use of the chief engineer's department and the tramways department.

Luton.—April 24th. Turbine generators, condensing plant, and cooling tower, for the Corporation Electricity Department. See "Official Notices" to-day.

Norway.—April 21st. Norwegian State Railway Authorities. Telegraph material, including galvanised-iron wire, hemp, sal-ammoniac, insulators, carbon plates, insulated copper cable and wire. Tenders, marked "Anbud paa telegrafmateriel," to "Styrelsens Expeditionskontor, Statsbanerne," Christiania. Copies of conditions, &c., to be seen at the Commercial Intelligence Branch of the Board of Trade.

Salisbury.—April 20th. Providing and fixing a copper lightning-conductor, for the B. of G. Mr. Harding, architect, 58, High Street, Salisbury.

St. Helens.—April 20th. One 1,500-KW. high-pressure turbo-alternator, with condensing plant and switchgear, for the Corporation Electricity Committee. See "Official Notices" March 31st.

Swansea.—April 24th. 2,000 brass condenser tubes, for the Corporation Electricity Department. See "Official Notices" to-day.

Turkey.—June 14th. H.M. Consul-General at Constantinople reports that tenders are invited by the Turkish Ministry of Public Works, Constantinople, for a concession for the public distribution of electrical energy and for electric tramways in Jerusalem and its suburbs. A deposit of £T2,000 (£1,800) is required with each tender, and the tenderer must also supply proof of his financial and technical ability to perform the work. Tenders, in sealed envelopes, marked "Ministère Impérial Ottoman des Travaux Publics: Adjudication de la concession de la distribution publique d'énergie et des tramways électriques de Jérusalem," will be received at the Ministry up to 2 p.m. on June 1st/14th. Local representation is essential in the case of Turkish Government contracts. A list of British commission agents established in Constantinople may be obtained, and a copy of the specification (in French) relating to the Jerusalem contract seen, by British firms at the Commercial Intelligence Branch of the Board of Trade, London.

H.M. Consul-General also reports that the adjudications for the concessions of electric tramway systems at Adrianople and Adana have both been postponed until May 2nd.

Stoke-on-Trent.—Electricity works plant, for the Borough Electricity Supply Committee. See "Official Notices" March 24th.

Walthamstow.—April 28th. Cooling tower and switchboard extension, for the U.D.C. Electricity Department. See "Official Notices" April 7th.

CLOSED.

Atherton.—The Electricity Committee has accepted the tender of Messrs. Callender's Cable and Construction Co. for 3,668 yards of cable, four section boxes, 3,668 yards of earthenware troughing, and 22 tons of genuine refined Trinidad bitumen.

Burnley.—The Electricity Committee has accepted the tender of Messrs. Keith & Blackman Co., Ltd. for two electric ventilating fans for the works, at £65.

The T.C. has decided that, subject to the sanction of the L.G.B., the tender of the British Westinghouse Electric and Manufacturing Co. shall be accepted for the supply of 1,500-KW. turbine plant for £6,433.

Crewkerne.—The tender of the Crewkerne Engineering and Foundry Co. has been accepted for the electrical installation at the Grammar School.

Egypt.—It is reported from Buda-Pesth that the Government of Egypt has entrusted the Ganz Electricity Co. with the contract for the erection of large electricity works for the supply of light and power in the town of Benisoueff, on the Nile. The company intends to establish an engineering office in Cairo in connection with the work.

Gloucester.—The Light Railways Committee has accepted the following tenders for a year:—

John Brown & Co., Ltd.—Car-wheel tires.
Tyne Metal Co.—Brake blocks.

Isle of Thanet.—The B. of G. has received the following tenders for 10 lightning conductors for the workhouse at Minster :—

Gray & Son	£40
Andrews & Co.	34

Liverpool.—The tender of the British Westinghouse Electric and Manufacturing Co., Ltd., has been accepted by the Corporation for two 500-KW. motor-generators for the Lister Drive power station. This is the initiation of the scheme proposed by Mr. A. B. Holmes, and already referred to in our pages, for the improvement of the generating station.

London.—L.C.C.—The Highways Committee has reported having considered the tenders received for four electric watering cars and four electrical equipments for watering cars required in connection with the Council's tramways, and also the tender from a selected firm for the supply of magnetic brakes for watering cars. It is of opinion that it would not be to the interest of the Council to accept any of the tenders received, and recommends accordingly.

The seal is to be attached to a contract with Messrs. Cammell, Laird & Co., Ltd., for 400 axle forgings for electric tramcars, at 36s. 9d. each, and 100 at 33s.

Messrs. Dick, Kerr & Co., Ltd., are to re-wind a motor-generator at Clapham sub-station for £422, the existing coils becoming their property.

The following tenders were submitted for 400 tons of rolled-steel bar for magnet shoes, and 120 tons of ditto :—

		Per ton. A*	B
Frodingham Iron & Steel Co., Ltd.	(accepted)	£6 19 6	£6 17 0
Lilleshall Co., Ltd.		7 0 0	7 0 0
Earl of Dudley's Round Oak Works		7 2 6	7 2 6
Shelton Iron, Steel and Coal Co., Ltd.		7 5 0	7 3 4
Buck & Hickman, Ltd.		7 10 0	7 10 0
H. Bessemer & Co., Ltd.		7 10 0	7 10 0
Cammell, Laird & Co., Ltd.		8 0 0	8 0 0
Coghlan Steel and Iron Co., Ltd.		10 10 0	10 10 0

* A or B according to place of delivery.

A large number of tenders have been accepted for the supply of tramway parts, equipment, &c., for the year.

The Education Committee received the following tenders for electric lighting at the Belvedere Place Trade School for Girls :—

G. Weston & Sons, Ltd.	(accepted)	£275
Tilley Bros.		348
Johnson & Phillips, Ltd.		357
A. Hawkins & Sons		369
Barlow Bros. & Co.		383
E. Newbald		396
G. Harland, Bowden & Co.		423
Tredegar & Co.		432
Mann, Egerton & Co., Ltd.		460
E. Lawrence & Sons, Ltd.		463

Deptford.—The Public Libraries Committee is accepting the tender of the General Electric Co., Ltd., for electric light fittings, at £52.

Penistone.—The U.D.C. has accepted the tender of Messrs. Chapman & Sons for electrically-driven pumping plant, at £369.

Shanghai.—We have received, just as we go to press, a copy of the *Municipal Gazette* of Shanghai, in which is reprinted the report of Messrs. Preece, Cardew & Snell on the tenders submitted for the extensions to the electricity works, concerning which Mr. Aldridge, the city electrical engineer, was recently in this country. We hope to deal more fully with this matter next week ; all we can do now is to mention that the following tenders are recommended :—

Turbo-generators.—Allgemeine Elekt. Gesellschaft, £15,025.
Boilers.—Babcock & Wilcox, Ltd., £14,805.
Main switchgear.—British Westinghouse Co., £1,512.
Transformers.—Allgemeine Elekt. Gesellschaft, £620.
Cables.—Siemens Bros., £12,079.

Stockport.—The T.C. has accepted the tender of Messrs. Geo. Robson & Co., of Sheffield, for a tram-rail grinder and driller ; and that of Messrs. C. Crossley & Son for double-streamer sanders for the tramways, at 3s. 11d. each.

Tonbridge.—The U.D.C. has accepted the following tenders :—

Medway Coal Co.—South Hetton rough small coal, for the electricity works for a year, at 15s. 9d. per ton.
Electrical Apparatus Co.—Meters above 5 amperes.
Bastian Meter Co.—Meters up to 5 amperes.
Western Electric Co., Ltd.—Cables.

Tunis.—La Compagnie des Tramways de Tunis has secured the contract for the supply of electrical energy for lighting and power purposes in the city of Tunis.

West Hartlepool.—The Corporation has accepted the tender of the Bastian Meter Co., Ltd., for 5-ampere and 2½-ampere Bastian meters.

Wrexham.—The following tenders have been accepted by the Electricity Department for a year :—

Cables.—No tender accepted.
Bitumen and box compound.—Dussek Bitumen Co.
Service cut-outs.—British Insulated and Helsby Cables.
Meters.—No tender accepted.
Arc lamp carbons.—General Electric Co.
Lubricating oils (crank chamber).—James Light & Son.
" (cylinder).—Henry Wells Oil Co.
Coal.—Barton & Co.
Boiler solution.—E. Wade Wilton.

NOTES.

Foreign Trade in March.—The Board of Trade returns for March show increases of £434,075 in imports, £6,472,354 in exports, and £739,678 in re-exports as compared with the corresponding month of 1910.

Imports :—Electrical goods and apparatus (other than machinery and telegraph and telephone wire) were £126,001 as compared with £126,395, a decrease of £394.

Machinery, £577,627, an increase of £136,105.

Exports :—Electrical goods and apparatus (other than machinery and telegraph and telephone wire) £268,598 against £758,160, a decrease of £489,562. This is due to an extraordinarily large item in the same month of 1910 for telegraph and telephone cables. For the year 1911, so far as it has gone, there is an increase of £107,954 compared with the first three months of 1910.

Machinery was £2,765,439, an increase of £416,272.

Gas and Electrical Matters in Constantinople.—It is stated that the Stamboul gas works, owned by the Société Ottomane pour l'Eclairage de la Ville de Constantinople, which is a Belgian company of Brussels, passed, on April 1st, into the possession of the holders of the concession (Ganz & Co., of Budapesth, and Fouquiau, of Paris) for the electric lighting of the Turkish capital, after the Banque de Bruxelles, as being largely interested in the Belgian company, had also agreed to the electricity concession. As the Société Ottomane pour l'Eclairage possessed a preferential right in regard to all kinds of lighting in Stamboul, this solution of the problem appears to be appropriate. The Ganz-Fouquian combination is declared to be in negotiation with the Constantinople Tramways Co., in which the Deutsche Bank and the Siemens-Schuckert Works have been prominently interested since last year, with the object of acting in co-operation in some way or other. As will be recollected, the tramway company has obtained a special concession for the conversion to electric traction of its lines in the town and suburbs, and intends to erect a power station which will be able to supply current in two years, whereas the holders of the electric lighting concession, it is said, will not have their generating station ready until 1915. If, however, the electric lighting combination and the tramway company were to join hands in the matter, it is considered that the arrangement would be of mutual advantage. A Budapesth report states that the central station to be undertaken by the Ganz Co. will involve an expenditure of £500,000, and will be equipped with alternating-current plant at 10,000 volts. The public electric lighting of the streets, owing to the existing gas lamps, will, at the beginning, be limited to 400 arc lamps and 500 incandescents of 150 C.P.

Institution and Lecture Notes.—Iron and Steel Institute.—The annual meeting of the Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on May 11th and 12th. Amongst the papers that are expected to be submitted are the following :—"On Magnetic Properties of some Nickel Steels," by E. C. Glauert, Ph.D., and S. Hilpert, D.Ing. ; "On the Action of Aqueous Solutions of single and mixed Electrolytes on Iron," by J. N. Friend, D.Sc., and J. H. Brown ; "On Iron-Silicon-Carbon Alloys," by W. Gontermann, Ph.D. ; "On Welding up of Blowholes and Cavities in Steel Ingots," by J. E. Stead, D.Met., F.R.S. The autumn meeting will be held at Turin, Italy, and will commence on October 2nd, and with the subsequent tour organised in connection therewith will occupy about 15 days.

Institute of Metals.—The Corrosion Research Committee of the Institute is preparing for an elaborate series of investigations into the causes of the corrosion of brass condenser tubes. A special condenser is being constructed, which will contain 48 tubes, 24 of these being made of commercially pure brass, and the remaining 24 tubes being made from brass containing a single selection from the following :—lead, tin, aluminium, manganese, or other materials at the discretion of the Committee. Experiments will be made with various water speeds in the ratio of 0 : 1 : 2 : 3 : 4, speed 2 being an average speed used in practice. The circulating water to be used will be obtained from deep water at Formby, off Liverpool, in the first instance, and the plant for the corrosion research will be installed in the University of Liverpool, where the experiments will be under the direct supervision of Mr. G. D. Bengough, M.A. The research will occupy many months before any definite conclusions can be reached, and will undoubtedly be costly. An appeal was recently made by the Committee for funds to carry on the research, in response to which £242 has been received, but the expenses will probably amount to not less than £300 per annum. It is therefore hoped that additional donations to the Corrosion Research Fund will be speedily forthcoming.

Tramways and Light Railways Association.—As announced last week, the Annual Congress will be held at Edinburgh on July 13th and 14th. In the course of the competition between the Royal Automobile Club and the Imperial Automobile Club of Germany, for the Cup given by Prince Henry of Prussia, the competitors are stopping at Edinburgh for two nights. It is proposed to hold a joint dinner of the representatives of these two clubs and of the Association on Friday, July 14th. The Hon. Arthur Stanley, M.P., will be in the chair, and it is hoped that among the guests will be H.R.H. Prince Henry of Prussia and H.S.H. The Duke of Teck (President of the Royal Automobile Club). Papers will be read and discussed during the mornings of July 13th and 14th.

On March 29th Dr. Gwilym Owen gave a lecture, fully illustrated by experiments, on "Electrons and Röntgen Rays," before the Liverpool British Insulated Engineering Society.

Prompt Delivery.—The following letter reached us too late for inclusion in our "Correspondence" columns :—

"I am much impressed by the account you give (page 560) of the marvellous achievement by a well-known firm. I hasten to congratulate both you and them. I really feel most envious of the lucky firm that got such prompt delivery. I hope the manufacturer about whom I am going to tell you has also seen the paragraph. He may get a twinge of conscience.

"About 18 months ago I required some motors, with a slight deviation from the usual practice. The modifications were purely mechanical and offered no real difficulty, technical or otherwise. It was merely a question of giving me exactly what I wanted. Among the firms who quoted was a certain firm X. Wild horses shall not drag the name from me.

"X submitted a sample, and, subject to slight alterations and a further sample, an order for 100 was given. After an interval of about six months, that is about three months ago, the second sample was submitted. The delay in delivery of the second sample was accounted for by the firm changing the office boy, and I am informed that it takes anyone about that period of time to get into the ways of this wonderful firm X.

"On examining the second sample, it was found to be practically equal to the requirements of the case, with the exception that a certain screw needed to be lengthened about ⅛ in., and an alteration in the colour of the paint was suggested. Now, this is evidently where I made the mistake of my life. It is strange how, as we advance in years, we find that the most trivial matters lead to most momentous issues. Who would imagine that ⅛ in. of screw and the matter of paint colour, might end in tragedy ?

"It appears that the order department of this firm X is in some manner controlled by a gentleman whom we will identify by the name of Zero. I understand that Zero has no particular qualification for the job, other than the fact that his great-aunt once cut the corns of the chairman of X.

"Now each order, before acceptance, has to be passed by Zero, and all alterations to samples must be approved by him before being passed on to the Works Department. Zero was much upset by my request for the further alterations. He took the lengthening of the screw as a personal affront, and the question of colour of the paint was, he stated, an attempt on my part to make him look small in the eyes of his great aunt. He point blank refused to make the alterations, and said he knew the motor as *he* had sent it in must be the correct one I wanted. When I meekly suggested I would be glad of a further reason for not agreeing with my reasonable requests to comply with the conditions of my order, he commenced to sulk and ceased to reply to my letters. I am now waiting for a reply to a final request to know whether they intend to deliver the motors or not.

"This letter was sent about three weeks ago. The net result of the whole business is this :—I am waiting for delivery of goods ordered over nine months ago, which could easily have been delivered in three months. I, and consequently X also, have lost the sale of over 300 of these machines. X may find that instead of making a profit on 300 machines, he will have to face a pretty large claim for damages.

"Now, if Zero had been in the employ of the firm you mentioned last week, how different things might have been.—PATIENCE.

"P.S.—Dentist.—A man who pulls teeth. Query, required the corresponding name for the man who pulls legs."

The Fire at the Capitol, Albany.—The disastrous fire by which immense damage has been done to the Capitol of New York State was, as usual, at once ascribed by the Press to the fusing of an electric wire. The organs of the gas industry both seized upon it as a choice brickbat to fling at electricity, of course. There is, however, no evidence whatever that electricity was in any way responsible for the fire. Mr. H. B. Renwick, chairman of the Electric Supply Publicity Committee, promptly telegraphed for confirmation or otherwise of the report, and was assured that the cause of the fire was quite unknown, but it was believed to be due to the dropping of a lighted match by a careless smoker.

The Coronation Illuminations.—While expectations are so high regarding the prospects of profitable electrical work in connection with the Coronation illuminations, it is as well to give heed to the timely word of caution to which the *Electrical Contractor* gives expression in its April issue. We quote a lengthy extract as follows :—

"*Go Easy!*—When we know a thing, better still when we have experienced a thing, it behoves us to tell others what we have experienced. And, so far as the Coronation is concerned, or rather, so far as the Coronation decorations are concerned, we both know and have experienced one or two little things. . . .

"Beyond all shadow of doubt London will be a city of dazzling light—dazzling electric light—and so will most, if not all, of our provincial towns. And, up and down the country, vast sums of money will be spent in these illuminations, BUT—and here we propose to apply the wet blanket—although good profits will be made on illumination work, unless our members and friends 'go easy' in the matter, the possibility of very substantial losses being made is equally worth keeping in mind.

"The pinch comes in the grand final rush. People put off their illuminations until the last minute, and rush about with what appear to be tempting offers to tradesmen to do this and to do that at the eleventh hour. Such rush work is all very well, but it must be paid for at very substantial rates if a profit is to be secured. All sorts of obstacles spring up during the last few weeks of such national 'getting ready' rushes. Labour is very scarce, and 'Jacks of all trades' come along demanding high rates of pay for doing (as may subsequently be found) more evil than good. In short, the cost of doing work during a national rush period is enormously advanced, and unless in our illumination estimates we keep this in mind, there will be more burnt fingers than oiled palms —at the finish.

"Here, for instance, is a simple matter. We have known such rush work hung up and money lost for lack of a ladder ! See if our words do not come true. In the last fortnight before the Coronation, ladders will be at a premium. You may go down on your knees and offer untold gold (or *almost* untold gold), but ladders will not be forthcoming. And this is just one little point. Hence, we say, beware of the eleventh-hour illumination contract *except* at substantial rates. Offers may come along that appear to be tempting, but—and we have had experience of this—quite a lot of money can be lost in a very short time at Coronation and similar periods of national rejoicing. Early orders by all means, but—in dealing with later orders—go easy ! "

Patent Office Returns.—The Report of the Comptroller-General of Patents, &c., for 1910, shows that the receipts from Patents fees were £276,904 as compared with £267,985 in 1909 : renewal fees brought in £161,063, an increase of £6,286, and sealing fees £16,643, an increase of £1,423. The surplus of the total receipts over expenditure was nearly £100,000. The total number of complete specifications filed amounted to 19,105, the largest number on record. Applications under the International Convention numbered 2,829, also a record : Germany, the United States and France accounted for the bulk of these, the figures being 1,172, 613 and 547 respectively.

Ironclad Switchgear.—We are informed by the makers of the switchboard illustrated on p. 550 of our last issue that it was supplied to the order of MESSRS. ELECTROMOTORS, LTD., Openshaw, for an electric power installation.

Inquiry.—Pocket meter reading books, with printed dials, are asked for.

An Electrical Goods Train for Roads.—An electric goods train for use on ordinary roads is described and illustrated by Gustav Braun in the *Technische Rundschau* of April 5th. The train consists of a generating wagon and six trailing motor-wagons, each of which is capable of transporting from 5 to 5½ tons, or a total of from 30 to 33 tons, at a speed of from 7½ to 9¾ miles an hour. The generating or driver's wagon is equipped with two dynamos, which are driven by two internal-combustion engines, and one electric motor is provided for driving each of the two axles. Each of the six trailing wagons is fitted with two similar motors for driving the two axles, so that all the axles throughout the train are electrically operated. Steering is effected from the driver's wagon, and the provision of suitable shafting between the trailers causes them to follow the bends or curves in the road taken by the generating wagon. It is claimed that the train, which is associated with the W. A. Muller Strassenzug Gesellschaft, is superior to any system of single-motor lorries, as the wagons can travel over rough ground, and even over sandy soil, without any sinking-in of the wheels, which are fitted with broad tires. The cost of working the train is said to be low, but no information is given as to whether the system, which presents a good and substantial appearance in the illustrations, has actually been adopted by any firm of carriers for the transport of heavy loads to and from railway stations.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Gillingham (Kent) T.C. has appointed MESSRS. LEE and COLLUM, of the Kent Electric Power Co.'s staff, as shift engineers.

MR. L. V. TURNER, of the Croydon electricity supply station, has been appointed to the post of switchboard attendant at Taunton.

Tramway Officials.—The Stockport T.C. has decided that the maximum salary for the joint position of borough tramways and electrical engineer and car-shed superintendent shall be £500 per annum, and that the salary of the present holder of the office be advanced from £450 to £475 on April 1st, 1913, and from £475 to £500 on April 1st, 1915. The Council has also fixed the maximum salary of the tramways manager at £300 per annum.

The Keighley T.C. has appointed MR. DOUGLAS GRAY, of Leeds, as tramway manager, at a salary of £175 per annum. He has been at Leeds since 1906, and is now assistant works manager and rolling-stock superintendent. There were 162 applicants.

General.—At a meeting of the heads of the South Lancashire Tramways Co., held the other day, it was decided to erect a memorial to the late manager, MR. J. R. SALTER. Subscriptions are being solicited from the employés.

Mr. Charles L. Edgar, president and general manager of the Edison Electric Illuminating Co., of Boston, and party sailed from New York on the *George Washington* on March 30th for an extended period of rest, which will be enjoyed in an automobile tour through Europe. About two weeks each will be spent in driving through England, France, Italy and Germany.

On the occasion of his marriage, Mr. T. L. Bowles has been presented by the Chelmsford staff of Messrs. Crompton & Co., Ltd., with a marble clock and ornaments.

We are asked to state that Mr. Donald Macleod is not now connected with the Bombay Electric Co.

Mr. Evan Parry, who has been associated with Mr. H. F. Parshall in the execution of a large number of important undertakings in this country, has been appointed by the Government of New Zealand, to take charge of the large hydroelectric projects that they have resolved to carry out. An Australian exchange says that Mr. L. Birks, formerly of Sydney, is to be engineer-in-charge at Rotorua.

We learn that Mr. P. W. Sothman, chief engineer of the Hydro-Electric Power Commission of Ontario, will be in England about the end of April, and will probably be reading a paper before the Institution of Electrical Engineers on the 110,000-volt transmission line which he has designed and carried out for the Ontario Government for supplying the province with power from Niagara Falls.

Obituary.—Mr. W. Middleton.—The death occurred, in a private hospital in Newcastle, on the 7th inst., of Mr. William Middleton, A.M.I.E.E., a well-known figure in local electrical engineering circles, who up to the time of his death, at the early age of 37, was assistant works superintendent to the Newcastle-on-Tyne and District Electric Lighting Co. On 6th inst. Mr. Middleton was examining the back of a switchboard at the power station in The Close, when a short-circuit occurred. His face and hands were badly burned, and the upper part of his clothing was in flames. A doctor was immediately sent for, and he was conveyed to the Gresham Private Hospital, where he succumbed to his injuries. At the Coroner's inquest the jury returned a verdict of "Death from shock following electric burns accidentally sustained." The jury expressed the opinion that a partition between the positive and negative bars should be provided in future to prevent danger from any accident or short-circuit. The deceased served his apprenticeship with Messrs. Parsons, and entered the service of the Lighting Co. 14 years ago. Mr. Middleton was an enthusiastic motorist, and also interested himself in aviation, being a member of the Northumberland and Durham Aero Club. He was married in 1899, and leaves a widow and four young children.

NEW COMPANIES REGISTERED.

Electrical Engineering and Agency Co., Ltd. (115,089).—This company was registered on April 4th, with a capital of £10,000 in £1 shares, to carry on the business of electricians, electrical and mechanical engineers, manufacturers of and dealers in electrical appliances, &c. The subscribers (with one share each) are:—W. a'Pittman, 10, Springwell Avenue, Harlesden, N.W., gentleman; A. G. Dobrant, 54, Mazenod Avenue, West Hampstead, N.W., clerk. Private company. The number of directors is not to be less than three or more than five; the subscribers are to appoint the first. Remuneration as fixed by the company. Registered by Slaughter & May, 18, Austin Friars, E.C.

Wellman, Head, Stothert & Pitt, Ltd. (115,083).—This company was registered on April 3rd, with a capital of £100 in £1 shares, to carry on the business of ironfounders, mechanical, hydraulic, electric, telegraph and general engineers, manufacturers of and dealers in steam engines, boilers, ploughs, agricultural implements and machinery, &c., and to adopt an agreement with Stothert & Pitt, Ltd., and Wellman, Seaver & Head, Ltd. The subscribers (with one share each) are:—B. W. Head, 47, Victoria Street, S.W., engineer; P. K. Stothert, M.I.C.E., Messrs. Stothert & Pitt, Ltd., Bath. Private company. The number of directors is not to be less than two or more than four, the first are W. Pitt, P. K. Sothert, B. W. Head and F. I. Sanderson. Registered by Bristows, Cooke and Carpmael, 1, Copthall Buildings, E.C.

Staniar, Clegg & Co., Ltd. (114,935).—This company was registered on March 27th, with a capital of £1,000 in 500 10 per cent. preference shares of £1 each, and 10,000 ordinary shares of 1s. each, to carry on the business of electrical engineers, dealers in electrical goods, switches, speedometers, cable, wires, dynamos, controllers, arc lamps, &c., and to adopt an agreement with H. D. Staniar and A. E. Clegg. The subscribers (with one preference share each) are:—J. Moorland, Mount Street, Manchester, estate agent; H. D. Staniar, 112, Portland Street, Manchester, electrical engineer. Private company. The number of directors is not to less than two or more than five; the first are H. D. Staniar and A. E. Clegg; qualification, £50. Registered office, 112, Portland Street, Manchester.

Electric and General Works, Ltd. (114,921).—This company was registered on March 27th, with a capital of £4,000 in £10 shares, to carry on the business of electricians, mechanical and general engineers, manufacturers and workers of and dealers in electricity, motive power and light, manufacturers of and dealers in electric carbon-filament, metallic-filament and other lamps, &c. The subscribers (with one share each) are:—G. Davies, 15, Victoria Street, S.W., electrician; A. Weill, 83, Goswell Road, E.C., metal merchant. Private company. The number of directors is not to be less than two or more than five; the first are J. Boussard, A. Fauchon, A. Dufour, G. Davis and A. Weill; qualification, £20. Registered by Messrs. Tippetts, 11, Maiden Lane, W.C.

CITY NOTES.

Reading Electric Supply Co., Ltd.

Mr. H. Collins presided recently at the annual meeting of this company, and in moving the adoption of the report and the declaration of a 2½ per cent. dividend, he said that the working costs again showed a decrease, and although the amount of the saving was comparatively small, it must be borne in mind that when they got down to a certain point, it was difficult to make further economies. The progress of the business was satisfactory. The number of units sold during 1910, as compared with 1909, was higher by 73,226, the increase in lighting amounting to 20,158, and the increase in power and heating to 53,068 units. On the other hand, the revenue for the past year showed an increase on the sales for lighting purposes of £1,049, and £128 for power and heating, a total increase of £1.177. They were carrying forward £524, as compared with £339. The accounts for the past year included for the last time the sum of £1,000, representing the balance upon the disused gas plant. That liability was now finally disposed of, and in the ordinary course of events, it followed that the company would be better off to that extent when they came to the declaration of a dividend in the year 1912.

Mr. Spencer Hawes, the consulting engineer to the company, in replying to the various points raised by Mr. Churchill, said that the supply in Caversham had been in operation only for a short period, and consequently had not yet produced much revenue. A fair demand, however, had already arisen, and as soon as the Caversham people realised that a supply of electricity was available the progress, he was satisfied, would be at a favourable rate.

Mr. John May pointed out that the progress last year was in reality much better than what it appeared to be. For the first three months they were slightly on the down grade in output. The deficiency, as compared with the corresponding three months of 1909, was in the neighbourhood of 20,000 units, and they had made up that, as well as shown a fair increase. That showed they had been going ahead in the latter part of the year at a good pace.

Guildford Electricity Supply Co., Ltd.

Mr. H. P. Smallpeice presided at the annual meeting, held at Guildford recently. In moving the adoption of the report, he referred to the satisfactory progress made during the year, the gross profit being £152 better than in the previous year. The progress was not rapid, but they hoped it would continue. The company's supply had now been extended to Shalford, and the directors felt sanguine that sufficient income would be derived from customers in that parish to justify the expenditure incurred. A new battery had been installed of double the capacity of any previous ones, and that had necessitated writing off £1,431 odd, this being the value at which the old battery stood in the company's books. To meet that the directors had recourse to the reserve fund, which was, fortunately, available for such purposes, and a small balance was left to carry forward.

After a few questions had been asked and answered, the report was adopted.

Isle of Wight Electric Light and Power Co., Ltd.

Mr. J. C. Wigham presided at the annual meeting at Ryde recently. In moving the adoption of the report and balance-sheet, he said that during the year the lamp connections had been increased by over 8,000, a much greater rate of increase than had taken place for several years past. They ascribed this increase to the growing popularity of electric lighting, which had been brought about by the use of the new metal lamps, which enabled consumers to get a very much greater amount of light for the same amount of money. The year's trading, after providing for debenture and loan interest, showed a balance of £7,685 as compared with £6,721 last year, an increase of £964. The preference share dividend which had been paid amounted to £2,500, leaving a balance to be dealt with of £5,186. The directors did not recommend any dividend on the ordinary shares at the present time, but proposed that £3,500 should be added to the renewal fund and £1,000 to the reserve fund, leaving a balance to be carried forward to the next account of £686. The past few years had been an anxious time for the directors of all electric lighting companies, and it was with much satisfaction that they saw brighter times ahead. The effect of the improved conditions under which electric lighting and power companies were now working had recently been shown by the marked increase in the prices of electrical securities on the Stock Exchange, arising from the greater demand for these securities. He had been approached several times during the past year by debenture-holders as to the reason of the low prices quoted for their stock. There had been practically no dealings in the stock, so that the official quotations had been quite nominal, but recently a good many inquiries had been made, with the result that the stock was now quoted at 91, which was a much more reasonable figure, though still considerably less than what he thought it was worth. The revenue was sufficient to pay the interest more than 2½ times, and the present price returned nearly 5 per cent. on the investment. The whole of the works of the company had been maintained in good working order and repair, over £1,200 having been expended for this purpose out of revenue.

Anglo-American Telegraph Co., Ltd.—After placing £5,000 to the credit of the renewal fund, the directors have recommended an interim dividend for the quarter ending March 31st, 1911, of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, less income-tax, payable on May 1st.

Stock Exchange Notice.—Application has been made to the Committee to appoint a special settling day in Metalite, Ltd.—150,000 shares of £1, each fully paid, Nos. 1 to 150,000.

Continental.—Austria.—The A.E.G. Union Electricitäts Gesellschaft, of Vienna, is declaring a dividend of 7 per cent. for the last financial year, the same as for the preceding year.

Bulgaria.—The balance-sheet of the Société de l'Eléctricité de Sofia et de Bulgarie for the last financial year shows a profit of £19,851, as compared with only £18,126 for the preceding 12 months.

American Telephone and Telegraph Co.

The report for the year ended December 31st states that the improvement which has marked previous years still continues. The net revenue for the year was $31,933,214, out of which were paid interest $5,077,321, and dividends $20,776,822. The balance, $6,079,071, shows an increase, notwithstanding the large increase in dividends due to the exchange of convertible bonds for shares. At the close of business December 31st, 1910, $111,059,000 of the $150,000,000 convertible bonds sold had been handed in for conversion, leaving outstanding at that date $38,941,000. Due to the conversion of the bonds, there has been an increase of $6,860,300 in the outstanding share capital. This increase has been well distributed. The number of shareholders (40,381) on December 31st, 1910, shows an increase of 4,558 during the year. There has been no issue of share capital during the year, except in exchange for convertible bonds. The amount of these bonds still outstanding at the time of this report is about $30,000,000. Some of the collateral fours have been issued in the course of the year in connection with the programme for re-arranging the territory, referred to last year, and other similar purposes. It will be necessary, the report adds, towards the close of the year to do some financing, and, should conditions remain much as they now are, this will probably be done by an issue of share capital to the stockholders. The time and amount of the issue will be determined later in order that any change in conditions may be taken advantage of. Last year the premiums received over the par value of capital issues were over $14,000,000. The conversion of bonds into stock during the year has increased this premium account to nearly $17,000,000.

The report is a very lengthy document of some 68 pages, and it enters into a great variety of questions regarding the company and its associated concerns, also its policy in relation to opposing companies, its "public relations," the relations between the telephone and telegraph system, and so forth.

The business of the American Telephone and Telegraph Co. is largely, but by no means entirely that of a holding company. It is an operating company in that it exercises centralised administrative functions over the associated companies and owns and directly operates the long-distance lines, binding this company into one system. It is a developing and manufacturing company by reason of its control over the manufacturing of the Western Electric Co. through the experimental and engineering departments and its contract relations with and stock ownership in that company.

The interest of the American Telephone and Telegraph Co. in its associated operating companies is over 80 per cent., in addition to which it has its own earnings. The American Telephone and Telegraph Co.'s share of the surplus earnings of the Bell system is approximately 90 per cent., so that the showing of real interest to the security holders of American Telephone and Telegraph Co. lies in the figures of the Bell system as a whole. The combined statements of the Bell system show that during the year the property of the whole system increased $84,000,000. This includes plant, real estate, supplies, tools, stocks and bonds. The cash and other liquid assets were reduced by $28,000,000. The intangible assets, such as contracts, patents, franchises, &c., were reduced by $4,270,000, leaving less than $3,000,000 on the books of all the companies against these items. The net increase in assets, about $52,000,000, was provided by an increase in outstanding obligations of less than $28,000,000.

It is shown that the construction costs of the Bell system are small. The cost per exchange station is $117.12. The cost per exchange station, including the extensive system of toll lines, is $142.13. This valuation includes the first-class exchanges and exchange construction. All, or substantially all, of the cheaper class of construction, the rural co-operative and association lines, is embraced in the sub-licensee or connected companies, constructed on that basis of giving a low-cost local service. It is shown that the cost of construction per exchange station has steadily decreased from $199.00 in 1900 to $142.00 in 1910, notwithstanding the great increase in the investment in real estate, underground construction, toll line construction and copper wire, and that instead of increasing and oppressive rates, there had been a continual decrease of the average annual charge for exchange service from an average of $44.68 in 1900 to $31.28 in 1910.

Year.	Net revenue.	Dividends paid.	Added to reserves.	Added to surplus.
1900 ..	$23,095,399	$17,036,276	$3,000,000	$3,059,113
1910 ..	$26,855,893	$20,776,822	$3,000,000	$3,079,071

Metropolitan Electric Tramways, Ltd.

The ordinary general meeting of the shareholders of the above company was held on Friday last at Electrical Federation Offices, Kingsway, W.C., Mr. E. Garcke, M.I.E.E., presiding.

The Chairman, in proposing the adoption of the report (see Electrical Review, page 565), said that the past year had been one of continued progress in the expansion of the business, both in regard to the conveyance of passengers and in regard to the business of electricity supply in the important area under the control of the Power Co. in the North of London. During the past year they had opened for operation nearly four additional miles of line. Part of that accretion was the extension of the Harrow Road and Paddington line to a point in the Edgware Road opposite the terminal station of the Baker Street Railway, which had brought them into contact with the Metropolitan at an additional point, and improving the position of the tramway system and its connection with the underground railways of London. The other extensions were at Finchley and Wembley, and since the closing of the accounts they had opened up an additional line at Ponders End, joining Enfield with the main line of the Great North Road. They had had 262 cars running during the year, as compared with 237 in 1909, and they found that even that number was inadequate to cope with the traffic. They had therefore hired some cars from the London United Tramways Co., at a cost of £1,093. They carried altogether 76 million passengers last year, as compared with 62 millions in the preceding year, and the receipts for the year were £393,000, as compared with £326,000 in 1909. Although the extensions had been in the more outlying districts, where the density of traffic was not quite so great and consequently the revenue per car-mile not so good as on the older lines, still they were able to maintain a very satisfactory average profit per route-mile—in fact, the profit had been larger in the past year than in the preceding years. The average profit per route-mile had last year amounted to £2,417, as compared with £2,342 in 1909. He would like to say a few words in regard to the very important business of electricity supply. That was carried on by a separate company, of which they held practically all the ordinary shares, amounting to £365,000, and that had been a very good investment. It yielded them a very fair return. Last year they received a dividend of 6 per cent. besides a bonus, amounting together to £26,000, which was rather more than the amount required to pay the dividend on the whole of their ordinary shares for the year, which amounted to £21,000. The Power Co. supplied 21 million units of electricity during the year, which represented an increase of 30 per cent. upon the preceding year. The business of the company was a large and comprehensive and an increasing one. It had added to its supply areas Southgate and Kingsbury, and they supplied several local authorities, including Willesden and Stoke Newington, with electricity in bulk, which was distributed by the local authorities. They were also supplying current to the tramways, which was a very considerable item, and, of course, they were supplying a very large amount of electricity for power purposes to various factories and power users in the district, a form of supply which promised to very largely increase. They were also supplying electricity in bulk to the subsidiary company which had provisional orders in Enfield, Barnet, Hertford and St. Albans, and the business of that company was developing very satisfactorily. It paid 4 per cent. for the past year on the shares which the Power Co. held—the first dividend they had received from that company since they acquired its properties. Turning to the profit and loss account, they would see that although the expenses showed an increase, the receipts on the other hand showed a larger increase, and the net balance showed a decided improvement over the previous year. The items of expenditure were undoubtedly large, but if they made comparisons with other tramway companies, he did not think they would find that it would be to the disadvantage of that company. They had spent a large amount in repairs and maintenance—£44,500. £19,000 of that was spent in repair and maintenance of the rolling stock, and £17,000 in the upkeep of the permanent way. The cost of the upkeep of their permanent way was heavy, but it must be remembered that the track was paved with wood for the most part—over 50 miles of wood paving had to be maintained, which was a very costly form of permanent way. In addition to spending that large sum on repairs and maintenance, they had further provided for renewals to the extent of £21,900. They believed they were making adequate, if not ample, provision for renewals that might have to be carried out in future years. The expenses in the profit and loss account included a very large item of no less than £76,700 for rents and payments to the local authorities. They had made a further reduction of the preliminary expenses by £3,000, and they had paid debenture and other interest amounting to £35,900, and after making all those payments they had a surplus of £53,767. They suggested that that should be applied to an addition to the reserve of £8,000, as against £6,000 last year; to the payment of the preference dividend amounting to £25,000; that they should pay a dividend on the ordinary shares of 5½ per cent., requiring £21,500—which was ½ per cent. more than was paid for 1909; and that they should carry forward the balance of £2,800. Speaking of dividends, he might mention that the directors had considered the suggestion which was thrown out at the last meeting, that it would be a convenience to the shareholders if they paid interim dividends on the ordinary shares as well as the preference shares. The board had decided to do that in future, and to pay a dividend for the half-year in October each year. He would like to mention that the renewals fund, after the £21,000 added last year, now amounted to £83,358, and of that sum over £52,000 was invested jointly with the Middlesex County Council in first-class securities, and a further amount would be so invested during the year. Of course, they could not carry on this big business, and provide for its extension, without further capital, and they had had to make an issue of £250,000 second debentures during the past year. They did not anticipate any further additions to the capital at present, and that being so they thought they might as well round off the issue of ordinary shares by offering the balance of £8,863 to the shareholders. There was no need to raise that money, but they thought they might just as well round off the capital account, but it was entirely a matter for the shareholders, whether they took up those shares or not. The directors made no recommendation on the subject, and desired to use no pressure. While, of course, they increased the capital by the issue of the second debentures last year, they were steadily reducing the first debentures by a sinking fund of 1 per cent. per annum, and they had already reduced those debentures by over £20,000. Next year a like sinking fund of 1 per cent. would come into operation in regard to the second debentures. With regard to future probable extensions of the business, they had practically completed the

tramway system as originally designed. There were a few small junctions still to be completed, for which purpose they had a Bill in Parliament this year. There was some probability of the Edgware Road extension being made by the Middlesex County Council and by the L.C.C., but as that Bill was before Parliament it was impossible for him to make any definite statement in regard to the result of that application this year. There was a proposition still on foot to extend the tramways to Watford, but that was surrounded by many difficulties, and it was a question for serious consideration, both by the local authorities and the company, as to whether the extension of the electric tramways was the best form of providing for the facilities needed in that particular district. That brought him to the question of what was the best way of providing for possible extensions into the outlying districts; extensions which no doubt would be pressed upon them, and some of which would probably be advisable, but which might not justify the heavy expenditure on permanent way. For that reason they had carefully considered the railless traction system which had already been carried out to an appreciable extent in various places on the Continent, and they had come to the conclusion that that system offered a very fair substitute for electric tramways in the more sparsely populated districts. The railless traction system meant, of course, a system without any permanent way—it was really an extension of the overhead system. It was an ordinary electrical omnibus running by means of current supplied from overhead wires, and was a very suitable system indeed for the purpose of extending electric tramways which had a common source of power. It was not a question of whether it was the most suitable system for a new district where there were no electric tramways; but they had to consider it from the point of view of the extension of the existing tramways, and they were certainly of opinion that the saving of the very large expenditure in laying down permanent way was a very desirable thing to strive for, and that if they could provide satisfactory travelling facilities in conjunction with their established system by means of a method which would avoid the expenditure on permanent way, it was very desirable to do so, and they believed that the railless traction system might enable them to accomplish that end. With regard to the future, he believed that the prospects of continued improvement were very good. They anticipated a very busy year. The various festivities connected with the Coronation, and other events which would take place during the current year, would undoubtedly bring additional traffic to the tramways, and would also lead to increased consumption of electricity. Therefore they looked forward to a prosperous year, and they trusted that the further expansion of the business that would take place might prove the foundation for continued prosperity in the future. In conclusion, he could only repeat what he had said on former occasions—that they were very fortunate indeed in having a very competent and efficient staff for the purpose of carrying out this important business.

Sir Ernest Spencer seconded the motion.

Mr. Ennis said he wished to congratulate the directors upon the addition of £21,000 to the reconstruction and renewals accounts. He would like to know whether there was any limit to the amount the company had to provide to satisfy the demands and claims of the Middlesex County Council in respect to their investment. He was not altogether pleased at the extra ½ per cent. which had been paid to the ordinary shareholders, and he hoped they would be satisfied with that dividend in the future, and allow the directors to make larger additions to the reserve, and thereby increase the chances of a dividend being paid on the deferred shares.

Mr. Spilsbury remarked that before the directors thought about embarking on further extensions, he considered they should develop the more profitable portions of their lines. That would give the deferred shareholders a better chance of getting a dividend on their shares, on which nothing so far had been paid, although they were issued 10 years ago.

Mr. Wimp, as an ordinary shareholder, suggested that the directors might well have paid 6 per cent. on the ordinary shares.

The Chairman, in reply, said that, of course, the wish of the directors was to meet the desires of all the shareholders as far as possible, and they would seem to have been fairly successful in striking an average. Mr. Ennis wanted 5 per cent., and Mr. Wimp 6 per cent., and as they had paid 5½, all parties should be satisfied. The only obligation upon them to provide for a renewals fund was the necessity of providing for the future, and they took that matter into consideration each year. Their practice for the past few years had been to put aside a sum proportionate to the car-miles run, and the only limitation was the money that would be required in future for carrying out necessary renewals. They wanted to provide such a fund that they might not be taken by surprise, and have to provide in any one year a larger amount than they could easily provide. As to the deferred shares, when they were issued he quite anticipated that in course of time they would become a thorn in their sides. They were issued quite seriously, but they were more by way of a paper compromise than by way of any definite promise or undertaking that they would be able to pay any dividend upon them. He had a hope that they might become remunerative, but he admitted that the hope was a deferred one. They would not, however, receive any dividend until there was more than sufficient to pay 8 per cent. to the ordinary shareholders in any one year.

The report was then adopted.

South Metropolitan Electric Light and Power Co., Ltd.

—The warrants for interest on the 4½ per cent. first mortgage debenture stock for the half-year to April 1st, 1911, were posted last week.

Cork Electric Tramways and Lighting Co., Ltd.

The directors' report for 1910 states that the result of the year's working is: Receipts £55,199, expenses £32,260, leaving £22,939, plus £514 brought forward and less interest on debentures £4,600, leaving a balance of £18,854. Of this amount £6,163 was paid on July 1st and January 1st for the half-yearly dividends on the 5 per cent. cumulative preference shares; £5,000 has been added to reserve for depreciation; £1,772 has been written off, and the directors recommend a 4 per cent. dividend on the ordinary shares, absorbing £4,600, leaving £1,319 to be carried to revenue new account. The directors report that the lighting and power business continues to show satisfactory progress. Owing to the increased popularity of electric lighting due to the great economy attainable by the use of metallic-filament lamps, there has been a substantial increase in the number of consumers, agreements for 168 additional connections being concluded during the past year for an equivalent of 11,786 8-c.p. lamps, compared with 9,430 8-c.p. lamps for 1909. There is also a continued demand for the supply of electricity for power purposes. The additional lighting and power consumers represent a total gain of 300 kw. as against 204 kw. in 1909. The lighting of Blackrock and Douglas districts referred to in the last report has been completed, and the supply is so satisfactory that the District Council has increased the number of public lamps originally contemplated. The total lighting and power receipts are £1,300 in excess of the previous year. The traffic receipts also show an increase of £2,054, the takings for the year being the best attained since the Cork Exhibition years of 1902 and 1903. The gross profits for the year show an increase of £2,761 as compared with the year 1909. Owing to increased demands it has been recently necessary to install an additional 1,000-h.p. boiler, and this has been put into satisfactory operation. The directors have written off £1,772 as per revenue account, and transferred £5,000 to reserve for depreciation, as compared with £2,666 and £3,500 respectively for the previous year. The capital expenditure during the year has been mainly expended on the Blackrock and Douglas district lighting, additional plant in power station, house services and cables. No shares or debentures have been issued during the year.

	1908.	1909.	1910.
Traction—			
Miles open	9·89	9·89	9·89
Passengers carried	5,737,478	5,349,041	5,704,071
Average fare	1·00d.	1.05d.	1·07d.
Car-mileage	896,945	864,228	899,173
No. of cars	35	35	35
Lighting and Power—			
No. of customers	1,987	2,013	2,181
8-c.p. lamps (equiv.) applied for	125,516	134,946	146,732
" " connected	121,906	128,186	139,403

Tynemouth and District Electric Traction Co., Ltd.

The report of the directors, which was submitted to the shareholders at their annual meeting in London, on Monday, states that the total revenue for the year ended December 31st, 1910, amounted to £13,723. After deducting all expenses chargeable to revenue, interest on debentures, and placing a sum of £600 to renewals account, there remained a surplus of £4,920, which, with £149 brought forward from last account, made an available balance of £5,069. The directors recommend that there be placed to reserve account £500; to sinking fund for debenture redemption, £1,000; a dividend on cumulative preference shares at the rate of 5 per cent. per annum for the year ended December 31st, 1910, £1,525; dividend on the ordinary shares at 4 per cent. per annum, £1,856; carried forward, £187. The reserve funds will then be as follow:—Reserve account, £7,000; sinking fund for debenture redemption, £5,832; renewals account, £2,300; total, £15,132. A joint arrangement has been entered into between the Newcastle Corporation, the Tyneside Tramways and Tramroads Co. and the Tynemouth Co. for the issue of cheap through return fares between Northumberland Street, Newcastle, and the Tynemouth Palace, over the lines of the three tramway authorities. This arrangement was inaugurated on May 13th last, with satisfactory results. The Tyneside Co. will shortly form a junction with the tramways of the Tynemouth Co. in Prudhoe Street, North Shields, for the purpose of improving the interchange of traffic between the two companies. The number of passengers carried in 1910 was 2,056,390, as compared with 2,044,034 in 1909, the average traffic receipts per passenger in 1910 was 1·53d. and in 1909 they amounted to 1·46d.

Brisbane Electric Tramways Investment Co., Ltd.—

Subject to final audit, the revenue account for the year 1910, including £1,952 brought forward from the previous year, shows an available balance of £98,015, which the directors have dealt with as follows:—In payment of debenture stock interest, £19,069; in payment of preference dividend £17,656; in payment of an interim dividend of 4s. per share on the ordinary shares, £15,000. Out of the remaining balance of £46,290 the directors recommend that a sum of £27,784 be added to the reserve fund (bringing same up to £42,000), and that a balance dividend of 4s. per share, free of income-tax, be paid on the ordinary shares (making a total dividend for the year of 8 per cent.), and that £3,506 be carried forward to next account. After the above appropriations the renewal and other reserve funds of both companies will amount to £120,000, with an aggregate of balances carried forward of £6,415. It is proposed to make the dividends payable on May 1st.

Bombay Telephone Co., Ltd.

The annual report of this company is given in the *Times of India* as follows :—The net result for the 12 months shows a profit of Rs. 1,90,922-12-9, including the sum of Rs. 1,331-3-0 brought forward from the previous year. Out of this available balance the directors propose to pay a dividend of Rs. 2-0-0 per share, equal to 8 per cent., which will absorb Rs. 67,150-0-0 ; to transfer Rs. 1,15,000-0-0 to depreciation account ; to recommend the distribution of a sum of Rs. 5,600-0-0 as a bonus to the company's staff ; and to carry forward the balance of Rs. 3,172-12-9. The directors have much pleasure in drawing attention to the very satisfactory progress which has been maintained since the last report. During the year under review there has been a net gain of Rs. 37,192 from 211 new subscribers in Bombay, and Rs. 9,488 from 62 new subscribers in Karachi ; the number of subscribers in Ahmedabad has decreased by one, but there has been an increase in revenue of Rs. 55. The result has been a total gain of 272 subscribers yielding an increase in revenue of Rs. 46,745. On December 31st, 1910, there were 2,467 exchange and private lines working in Bombay, Karachi and Ahmedabad with a total gross revenue of Rs. 4,17,620. The laying of the underground cables in the Malabar and Cumballa Hill districts is now finished, and all the lines working in the Cumballa Hill Exchange have been transferred to the Central Exchange. Owing to the necessary negotiations with the local authorities in Karachi having been somewhat protracted, the work of laying underground cables there has not yet been commenced. Arrangements have, however, now been completed, and the cables have already been shipped from England, and on their arrival the work of laying will be undertaken. Arrangements have also been made to extend the company's local system to Ghat Kopar, and it is hoped to open an exchange there at an early date.

Alderley and Wilmslow Electric Supply, Ltd.

The directors report that further progress has been made during the year 1910, the total connections having been increased from an equivalent of 19,114 to 21,377 8-c.p. lamps. The profit on the year's working, including £4 8s. 5d. brought forward, amounts to £2,201, and after paying £1,522 interest on debentures and loans, there remains a balance of £679, of which the directors recommend that £550 should be put to the reserve fund, and the balance of £129 carried forward.

The annual meeting was held in Manchester on March 31st. A local paper mentions, as showing the progress of the company, the necessity of providing additional plant to meet the increasing demand during the next few months. It is intended to install a 200-h.p. Diesel oil engine.

Units generated, 218,181 ; quantity sold, 165,208 ; (public lamps, 25,690 ; private consumers by meter, 139,518) ; quantity used on works, 43,054 ; total accounted for, 208,262 ; not accounted for, 9,919 ; number of public lamps, 245 ; total maximum supply demanded, 150 kw.

Canadian General Electric Co.—The report for the past year (as quoted by the *Financier*) shows satisfactory progress, and extensions of works and plant have been rendered necessary by the growth of business. The gross profit for 1910 was nearly 50 per cent. over the previous year's ; after deducting expenses, depreciation and interest charges, there remains an increase of $151,700 in the balance forward, after maintaining the preference and common stock dividends at 7 per cent. Unfinished orders, no profit from which has been included in the past year's account, are carried forward to the value of $4,000,000, whilst orders are still being received in satisfactory volume.

Another paper says that the Peterborough works have been extended, and will be fully equipped by the beginning of next month. The structural steel department has been extended, necessitating an increase of $267,568 in the mortgage indebtedness.

Coalite, Ltd.—The report states that the financial position of the company has been much improved by the adjustment of the liability of £170,409 to the British Coalite Co., Ltd., which has been discharged under an arrangement made with that company, to the benefit of both companies. The prosperity of the British Coalite Co., Ltd., is necessarily of considerable importance to this company, holding as it does 134,094 fully-paid ordinary shares, and 456,500 fully-paid deferred shares. The directors are, therefore, glad to be able to report that, after passing through a somewhat critical period, the affairs of the British Coalite Co. are now in an improved condition and on a businesslike footing. Pending the reorganisation of the British Coalite Co., Ltd., it was considered inadvisable to take any steps for the disposal of this company's foreign patents, but the board is of opinion that within a short time it will be able to take active steps towards their realisation.—*Financier.*

Indo-European Telegraph Co., Ltd.—The directors, subject to final audit, recommend the payment of a dividend for the six months ending December 31st, 1910, of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year, and a bonus of 20s. per share, both free of income-tax. They also recommend a special distribution of 15s. per share, free of income-tax, out of interest accrued during the year upon certain investments and advance accounts. The dividend, bonus and special distribution will be payable on and after May 1st next to shareholders registered on April 27th. **The transfer books will be closed from April 14th to 27th inclusive.**

South Wales Electrical Power Distribution Co.

Mr. W. Gascoyne Dalziel presided over the annual general meeting at the Park Hotel, Cardiff, on Tuesday last week. From a report of the proceedings in the *Western Mail*, we gather that the Chairman said that the past year showed a steady and continuous expansion of business ; several new colliery undertakings, the pits of which were now in course of being sunk, had been connected, and as these collieries were developed they would be a source of considerable revenue to the company. As an illustration of the progress which had been made, it was interesting to compare the output in the combined Treforest and Cwmbran areas in 1907, when the present board took office, with the corresponding figures for 1910 :—Units sold in 1907, 8,777,420 ; units sold in 1910, 11,548,253. This marked improvement was in spite of the fact that the 1907 figures included 2,990,570 units supplied to consumers who then put down their own generating plant and ceased to take a supply from the company. There was also a substantial reduction in the cost per unit generated, the cost in September, 1907, having been reduced by about 45 per cent. in December, 1910. The results obtained as regarded economy from the working of the turbine plant already installed, although not yet fully up to the contractors' guarantees, had thus shown a very large saving in fuel consumption and in other incidental costs of working. A second turbine now being put in would, it was hoped, be still more economical. It was further very gratifying to report that two large and important colliery companies had decided to take their electrical energy from that company, namely, the Rhymney Iron Co., Ltd., and the Newport-Abercarn Black Vein Steam Coal Co., Ltd., at their existing collieries. The latter company commenced to take their supply in September last, and were now extending their electrical installation, and the Rhymney Co. had joined the Treforest Co., and subscribed capital thereto for the purpose of obtaining a supply at their Pengam and Groesfaen Collieries. The contract had been let for the construction of the line to connect up these collieries, which it was anticipated would be completed in four months. In addition to these new consumers, the consumers who were members of the Treforest Co. were extending their electrical plant from time to time and increasing their consumption, and in order to meet the growing demand the Treforest Co. had placed an order for a second 3,000-kw. turbine set and other plant, which would shortly be delivered. The available generating plant would then equal fully 6,000 kw. apart from the stand-by engines, which equalled about 3,500 kw. The Treforest Co. had arranged to find a further £20,000 of capital on the security of prior lien debenture stock as before to meet these extensions, and they were now inviting subscriptions from the share and debenture stockholders to an additional £30,000 of prior lien debenture stock. Ever since the present board of directors took office in 1907 they had been handicapped by the fact that there had been no funds available for the construction of connecting lines and feeders to secure new consumers. It had been necessary in negotiating with possible consumers to stipulate that they should either join the Treforest Co. and provide the necessary funds in that way, or themselves bear the cost of connecting up. The matter had been gone into very fully with some of the largest shareholders and debenture stock holders, who had approved of the issue of the further £30,000 prior lien debenture stock, and had agreed to subscribe for their proportions. Very careful estimates had been prepared, based upon experience already gained, and there was every reason to believe that with the expenditure of the further £50,000 new capital now being provided for, the prospects of the undertaking would be very materially improved. The wisdom of the course taken by the directors in 1909 in constructing the connecting line between the Treforest and Cwmbran areas and shutting down the Cwmbran station had been amply demonstrated. The supply of current to the Cwmbran area had since May, 1909, been given from the Treforest generating station by means of this connecting line, and the arrangement had worked very satisfactorily, effecting a material reduction in works costs. The acquisition of the Caerphilly Electric Lighting Order referred to at their last meeting had been completed, and the Treforest Co. were now supplying energy for public and private lighting in certain parts of the Caerphilly Urban District Council's area, and were at present carrying out further extensions.

Mr. Westgarth Foster Brown seconded, and the report was adopted unanimously.

Wolverhampton District Electric Tramways Co., Ltd.—The directors report that the accounts for the year to December 31st, after including £263 brought forward, and providing debenture interest and £1,000 for the renewals fund, show a credit balance of £659, which is to be appropriated as follows :—To be placed to sinking fund, £250 ; to depreciation and reserve, £250, carrying forward £159. The meeting was held on Monday.

Dudley, Stourbridge and District Electric Traction Co., Ltd.—The directors' report states that the accounts for the year to December 31st, after placing £600 to renewals account, deducting the dividend on the preference shares accrued to December 31st, and adding £12 brought forward, show an available balance of £1,060. Of this there is to be placed to depreciation and reserve, £600 ; to sinking fund, £300 ; and £160 is to be carried forward. The meeting was held on Monday.

Babcock & Wilcox, Ltd.—The directors have declared **a further dividend of 8 per cent., making 18 per cent. for the year to December 31st ; they also recommend a bonus of 8 per cent.**

MARKET QUOTATIONS.

Monday, April 10th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	„ Nitric	„	22/-	..
a	„ Oxalic	„	28/-	..
a	„ Sulphuric	„	5/6	..
a	Ammoniac, Sal	„	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£29	..
a	„ „	„	£30	..
a	Bleaching powder	„	£5 10	..
a	Bisulphide of Carbon	„	£18	..
a	Borax	„	£16	..
a	Ferro-Silicon (50 %)	„	£12 10	..
a	Copper Sulphate	„	£20	£1 dec.
a	Lead, Nitrate	„	£25	..
a	„ White Sugar	„	£22 15	..
a	„ Peroxide	„	£32	..
a	Methylated Spirit	per gal.	2/6	..
a	Potassium, Bichromate, in casks	per lb.	8½d.	..
a	Potash, Caustic (75/80 %) ..	per ton	£20	..
a	„ Chlorate	per lb.	8½d.	..
a	„ Perchlorate	„	4½d.	..
a	Potassium, Cyanide	„	7d.	..
a	Shellac	per cwt.	75/-	5s. dec.
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	„	£6 10	..
a	„ Recovered	„	£5 10	..
a	„ Lump	„	£5	..
a	Soda, Caustic (white 70 %) ..	„	£11	..
a	„ Chlorate	per lb.	3½d.	..
a	„ Crystals	per ton	£3 5	..
a	Sodium Bichromate, casks ..	per lb.	3d.	..
a	„ Cyanide (basis 100 %) ..	„	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£75	..
b	„ Wire, in ton lots ..	„	£102	..
b	„ Sheet, in ton lots ..	„	£120	..
p	Babbitt's metal ingots	„	£38 to £145	..
c	Brass (rolled metal 2" to 12" basis	per lb.	6¼d.	..
c	„ Tube (brazed)	„	8¾d.	..
c	„ „ (solid drawn) ..	„	6¾d.	..
c	„ Wire, basis	„	6¾d.	..
c	Copper Tubes (brazed)	„	8¼d.	..
c	„ „ (solid drawn ..	„	8¼d.	..
g	„ Bars (best selected) ..	per ton	£70	..
g	„ Sheet	„	£70	..
g	„ Rod	„	£70	..
e	„ (Electrolytic) Bars ..	„	£57 7 6	..
e	„ „ Sheets ..	„	£73 2 6	..
e	„ „ Rod ..	„	£60 12 6	..
e	„ „ H.C. Wire	per lb.	7/16d.	..
f	Ebonite Rod	„	6/-	..
f	„ Sheet	„	5/6	..
n	German Silver Wire	„	1/11	..
h	Gutta-percha, fine	„	8/6	..
h	India-rubber, Para fine	„	5/10½	1½d. inc.
l	Iron Pig (Cleveland warrants) ..	per ton	47/-	7½d. dec.
l	„ Wire, galv. No. 8, P.O. qual.	„	£14	..
g	Lead, English Ingot	„	£13 2 6 to £13 7 6	..
m	Manganin Wire No. 28	per lb.	6/6	..
g	Mercury	per bot.	£9 5	..
d	Mica (in original cases) small ..	per lb.	6d. to 1s.	..
d	„ „ „ medium	„	2/6 to 4/-	..
d	„ „ „ large ..	„	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	„	11d.	..
p	„ „ rolled bars & rods	„	1/0½	..
p	„ „ rolled strip & sheet	„	1/1	..
o	Platinum	per oz.	166/6	..
e	Silicium Bronze Wire	per lb.	8 7/16d.	..
r	Steel Magnet, in bars	per ton	£55	..
g	Tin, Block (English)	„	£187 to £188	..
n	„ Wire, Nos. 1 to 16	per lb.	2,2	1d. inc.
p	White Anti-friction Metals ..	per ton	£45 to £160	..
k	Zinc, Sh't (Vieille Montagne bnd.)	„	£28	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Resuscitation from Electric Shock.—An interesting case of resuscitation from apparent death caused by electric shock is quoted by the *Electrical World*. In the place where the accident occurred the three-phase wires of a 7,500-volt, 55-cycle circuit were placed on a bracket fastened to the wall about 20 ft. above the ground. A lineman had climbed up to this bracket in order to work on some telephone wires, and accidentally took hold of one of the high-tension wires. It was several minutes before the line was disconnected, about 15 minutes before the man was found, and half an hour before he was brought to the ground; that is, about 50 minutes elapsed from the time of the shock until the first efforts at resuscitation were made. When brought to the ground the victim of the shock did not give any sign of life, and attempts were made to produce artificial respiration by movements of the arms, &c., principally following the Sylvester method, but without effect. As hope was about to be abandoned, it was recalled that instructions relating to the tongue had been neglected, whereupon the mouth was forced open and the tongue pulled out and allowed to recede rhythmically. Almost at once the patient responded and commenced to breathe, and after two hours the man not only had regained consciousness, but, with the exception of a few burns, was in normal condition.

STOCKS AND SHARES.

Saturday Afternoon.

With the holidays so near at hand, and printers clamouring for copy about three days earlier than usual, it is not likely that the markets show any particular animation in the first place, or that the industrious scribe finds much scope for writing about them in the second. The surprising part of it is that the Stock Exchange as a whole is certainly busy, and the Home Railway Market shows a reserve of strength which augurs well for a recurrence of activity after Easter.

One of the main features of the past few days has been a swift rise in East Londons to 8, from which the price dropped as smartly to 7⅛. The Debenture Stocks moved in somewhat similar ratio, and the "D" stock, after getting up to 12, went back to 10, while the Third Debenture kept fairly steady at 15 and the Second at 34. There are persistent rumours that the electrification is going to be commenced without further delay, but this has raised the consideration that more money may be required to pay for the change, and it is considered doubtful whether the four companies working the line will be content to put up the cash amongst themselves. Rather it is expected that the East London will make a new issue to its own proprietors.

Undergrounds are mostly steady, but Metropolitans, after touching 55¼, went back to 54⅞, while Districts remain hard at 32¼. City and South London stock, after being 35, receded to 33½, and the Central London trio shows practically no change. There have been very jerky movements in Brighton Deferred, which at one time rose to 112, falling back to 110¼ before rallying to midway between these prices. Here again, a new capital issue will, of course, be necessary when the company takes in hand the electrification of its full system.

The new Mexican Northern Power Bonds have been dealt in freely on the basis of ½ to 1 premium, and the Common Stock is quoted at 30-31. The former, of course, carry the rights in respect of the bonus in the shape of the latter, and sellers of the Bonds will do well to bear this in mind, in case they think that by realising they can make a much more handsome profit than is actually the case. This group as a whole is slightly irregular. Sharp movements occurred in Rio Trams, the price rising to 112 and falling back suddenly to 110. Sao Paulo Trams went up to 170, and the 5 per cent. First Debentures strengthened to 103¼. In the Mexican issues, Tramways Common Stock remains about 127½, and the power descriptions show little change. There has been a certain amount of business going on in the 5 per cent. First Mortgage Debenture stock of the Monterey Railway and Power, the price being 90⅞.

Home Traction shares are mainly good. British Traction Preference have been dealt in extensively on the basis of £5 middle, and the 5 per cent. Debenture stock at about 96. More trade, too, is going on in Metropolitan Electric Tramways, the recent report stimulating orders. The 5 per cent. Preference shares have come into some prominence as good investments of their class, the price being about 18s., but there has been no further move in the Deferred shares, which stick about 3s. 9d.

It would take a cleverer pen than that now in use to disguise the fact of business and interest in electric lighting shares being at standstill. Last Friday, for example, there were two, and only two, bargains recorded in all the shares quoted in the Electric Lighting and Power section of the Stock Exchange Official List. So this department can be left severely alone just at present.

National Telephone Deferred stock keeps very near 137, not far short of the top price reached in the recent boomlet. The legal gentlemen have been at work this week in relation to an appeal (which was allowed) by the National Telephone Co. from an order of the Registrar giving the Postmaster-General certain rights of interrogation. During the hearing of the case it transpired that some 600 men are busy preparing an inventory of the property to be taken over by the Government. The 3½ per cent. and the 4 per cent. Debenture stocks, it is curious to observe, stand at the same price of 100½, interest on both being payable at the end of June and December. New York Telephone 4½ per cent. bonds are good at 101, which carries the interest due on May 1st.

Anglo-American Telegraphs were not affected by the declaration of the regular quarterly dividends on the Preferred and Ordinary stocks. Speculation in the Deferred is falling away to a low ebb, displaced, like Telephone Deferred, by the activity in other issues that happen to be more popular for the time being. Eastern Extension Telegraph Ordinary are a good market, and considerable activity has developed in them on the basis of 13½. Eastern Telegraph Ordinary stock remains around 137½. West India and Panama Telegraph shares are steady at 2⅞, and other issues in this market keep very firm.

Manufacturing and Miscellaneous shares show, on the whole, an improving disposition, with changes slight and business quiet. The Babcock & Wilcox increase of dividend, and the splendid showing made by the figures of the declaration, have been somewhat discounted by the rise that has been taking place in the shares, the price of which is just firm.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations April 4th.	Closing Quotations April 8th.	Business done week ended April 8th, 1911.		Rise + or Fall —	Present Yield per cent
		*	1907.	1908.	1909.	1910.			Highest	Lowest.		£ s. d.
300,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	6½ — 6⅝	6½ — 6⅝	..	..	+ ⅛	Nil.
$263,244,000	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	96¾ — 98½	97 — 99	..	..	+ ½	5 1 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	8 %	148 —150	150 —152	150¾	..	+2	5 5 3
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
545,920	Anglo-American Telegraph	Stock	3½%	£3 4s.	3⅜%	3⅜%	69 — 71	69 — 71	69½	..	..	5 5 8
3,227,040	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	112½—113½	112½—113½	113½	112½	..	5 5 9
3,227,040	Do. do. do. Deferred	Stock	1 %	8/-	25/-	30/-	26⅜ — 26¾	26⅜ — 26⅝	26¾	..	..	5 11 1
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	7 1/16 — 7 5/16	7 1/16 — 7 5/16	..	..	..	5 9 5
2,462,309	Commercial Cable, Sting. 500 year 4% Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	87 — 89	87 — 89	..	..	..	4 9 11
16,000	Cuba Telegraph	10	6 %	6 %	6 %	..	9½ — 10½	9½ — 10½	..	..	..	5 9 1
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	17½ — 18½	17½ — 18½	..	..	..	5 9 7
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4%	3¾ — 4	3¾ — 4	..	..	..	5 0 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10%	8¼ — 8¾	8¼ — 8¾	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
60,710‡	Direct United States Cable	10	4½%	4½%	4 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	7⅞	7 27/32	..	6 3 1
32,500	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	135 —138	135 —138	137⅜	136½	..	5 2 2
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	84 — 86	84 — 86	..	..	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	101½—103½	101½—103½	103	..	..	3 17 10
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13¼ — 13⅝	13¼ — 13⅝	13⅝	13 5/16	..	5 1 10
752,400	Do. 4 % Deb. Stock..	Stock	4 %	4 %	4 %	4 %	99½—101½	99½—101½	101½	..	..	3 18 10
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103	101½	..	..	3 17 8
181,127	Globe Telegraph and Trust	10	5⅞%	5⅞%	5⅞%	..	10½ — 11	10½ — 11	10⅝	10 11/32	..	5 4 4
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13 — 13½	13 — 13½	..	..	..	4 8 11
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	18 %	18 %	18%	32 — 33	32½ — 33½	32½	..	+ ½	5 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13%	58 — 60	58 — 60	..	..	..	5 8 4
$41,380,400	Mackay Companies Common	$100	4 %	4 %	4½%	5 %	93 — 96	93 — 96	..	..	..	5 4 2
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	78 — 80	78 — 80	..	..	..	5 0 0
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞ — 1	1 1/16 — 1 1/16	19/9	18/3	+ 1/16	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	20/3	19/6	..	5 17 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	1 3/32 — 1 5/32	1 3/32 — 1 5/32	..	..	..	5 11 1
2,235,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	104 —105	104 —105	104⅝	104½	..	5 14 3
3,725,000	Do. do. Def. Stock	100	6 %	6 %	6 %	6 %	136½—138½	136½—138½	137	136⅜	..	4 6 8
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10⅜	10 — 10⅜	..	..	..	5 11 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 11	10½ — 11	..	..	..	5 9 1
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅞	5⅜ — 5⅞	5⅝	..	— ⅛	4 4 3
2,300,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 —101	99 —101	..	..	..	3 9 3
1,988,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	99½	..	..	3 19 4
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	8 %	8 %	8 %	..	1⅜ — 1⅜	1⅜ — 1⅜	..	..	..	4 11 5
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	87 — 89	87½ — 89½	88	..	+ ½	4 0 5
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 7
11,839	Reuter's	8	5 %	5 %	5 %	..	7⅜ — 8⅛	7⅜ — 8⅛	..	..	+ ⅛	4 10 11
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	96½ — 98½	98½ —100½	..	..	+2	4 9 7
2,992	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	133 —136	134 —137	..	..	+1	4 7 7
150,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7⅞ — 7⅞	7⅞ — 7⅞	7 11/16	..	..	5 3 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅝ — 5⅝	5⅝ — 5⅝	..	..	..	4 7 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1½ — 1½	1½ — 1⅝	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 — 101	99 —101	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	6 %	13¾ — 14	13¾ — 14	..	..	..	4 5 9
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 19 3
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	2⅜ — 2⅞	2⅜ — 3	58/9	56/10½	+ ⅛	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10⅜ — 10⅝	10⅜ — 10⅝	..	..	..	5 12 11
4,669	Do. do. 6 % Cum. 2nd Pref.	10	£2 6	15 %	14½%	..	9 — 9½	9 — 9½	..	..	..	6 6 4
80,000‡	Do. do. 5 % Debs., Nos. 1 to 800 ..	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	+ ½	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	5 %	5 %	5 — 5½	5 — 5½	5⅝	5 1/32	..	4 15 3
500,000	Do. 5 % 2nd Pref., 800,000 to 1,800,000	5	..	..	5 %	5 %	4¾ — 5	4¾ — 5	..	..	..	5 0 3
4,465,674	Do. 4 % Deb. Stock	Stock	..	4 %	4 %	4 %	92 — 93½	92 — 93½	92⅝	92½	..	4 5 7
329,002	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	104½—106½	104½—106½	..	..	..	4 18 11
880,000	Babcock & Wilcox, 1 to 880,000	1	20 %	20 %	24 %	26 %	5⅜ — 5¾	5⅜ — 5⅝	5 13/16	..	..	4 4 9
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..	4 0 0
600,000	British Columbia E. Rail Def. Ord. Stock	100	8 %	8 %	8 %	..	151 —155	151 —155	153	151	..	5 3 3
600,000	Do. Pref. Ord. Stock	100	5 %	6 %	6 %	..	125 —128	125 —128	125¾	124¾	..	4 10 1
600,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	108 —111	108 —111	109	..	..	4 5 9
230,800	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 6 7
210,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
133,301	British Electric Traction	10	Nil	Nil	Nil	..	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	3 %	1½%	Nil	..	4 1/16 — 5 1/16	4⅛ — 5⅛	101/3	96/10½	— 1/16	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	94 — 98	94 — 98	96½	95	..	5 2 0
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	78 — 83	80 — 85	..	..	+2	5 5 11
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6⅛	5⅞ — 6⅛	6 1/16	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	101 —103	101 —103	102	..	..	4 7 5
201,579‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
500,000	British Westinghouse 10 % Pref., 1 to 200,000 and 275,001 to 575,000 Non-cum.	5	Nil	Nil	Nil	..	5/16 — 7/16	5/16 — 7/16	..	..	..	Nil
1,241,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 62	59 — 62	..	..	..	6 9 1
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,838	Brush Electrical Engineering, Ord., 1 to 140,838 ..	2	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
199,885	Do. do. Non-cum. 7 % Pref.. ..	2	Nil	Nil	Nil	..	3/32 — 1/8	3/32 — 1/8	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock.	Stock	4½%	4½%	4½%	4½%	56 — 61	56 — 61	..	..	..	7 7 7
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	38 — 43	38 — 43	..	..	..	10 9 4
137,610	Calcutta Trams, 1 to 137,610	5	6 %	4½%	4½%	..	5⅜ — 5⅞	5⅜ — 5⅞	..	..	..	3 16 7
47,295	Do. 5 % Cum. Pref., 1 to 47,295 ..	5	5 %	5 %	5 %	..	4⅛ — 5⅛	4⅛ — 5⅛	..	..	..	5 0 0
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 — 100	97 —100	..	..	..	4 10 0
35,000	Callender's Cable Construction shares	5	15 %	15 %	10 %	..	9⅜ — 9⅞	9⅜ — 9⅞	..	..	..	5 1 3
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4⅛ — 5⅛	4⅛ — 5⅛	..	..	..	4 17 1
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	10/7½	10/-	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	12 %	12½%	17½%	..	3 1/16 — 3 3/16	3 1/16 — 3 3/16	65/9	64/6	..	5 7 8
205,369	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4 %	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
1,354,720	Central London Railway, Ord. Stock	Stock	3 %	3½%	3 %	3 %	72 — 74	72 — 74	..	..	..	4 1 1
572,640	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	87 — 89	87 — 89	..	..	..	4 9 11
572,640	Do. do. Def. do.	Stock	2 %	2½%	2 %	2 %	57 — 59	57 — 59	58½	..	..	3 7 0
1,480,000	City and South London Railway	Stock	2½%	1½%	1⅜%	1½%	34 — 35	33 — 34	34½	33½	—1	4 8 3
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	Nil	Nil	..	½ — ½	½ — ⅝	5/-	..	— 1/16	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 1,100 of £50 Red.	..	5 %	5 %	5 %	5 %	70 — 80	70 — 80	..	..	..	6 0 5

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations April 4th.	Closing Quotations April 8th.	Business done week ended April 8th, 1911.		Rise + or Fall —	Present Yield per cent.
		*	1907.	1908.	1909.	1910.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	6 %	5 %	..	7/16 — 1	7/16 — 1	..	..	.	5 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1 1/8	1 — 1 1/8	..	..	..	5 6 8
265,430	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	97 —100	97 —100	..	..	..	4 10 0
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12 3/4 — 13 1/4	12 3/4 — 13 1/4	..	..	..	4 10 7
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½ %	Nil	Nil	..	3/16 — 1/4	1/4 — 5/16	10/9	..	..	Nil
17,139	Do. "A" shares, 01—017,139	5	2½ %	Nil	Nil	..	1 3/4 — 2 1/8	1 3/4 — 2 1/8	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	67 — 71	69 — 73	..	..	..	5 12 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	78 — 81	78 — 81	..	..	..	6 3 5
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	3/4 — 1	3/4 — 1	17/-	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1 1/2 — 2	1 1/2 — 2	..	..	..	7 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	8 — 8 1/4	8 — 8 1/4	..	..	..	5 17 8
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	83 — 88	83 — 88	..	..	..	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	1/2 %	Nil	Nil	..	1 1/8 — 1 1/4	1 1/8 — 1 1/4	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10 1/4 — 10 3/4	10 1/4 — 10 3/4	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103 1/2	102 —103 1/2	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12 — 12 3/4	12 — 12 3/4	12 1/8	..	..	5 9 1
40,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	4 15/16 — 5 3/16	4 15/16 — 5 3/16	..	..	..	4 6 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½ %	4½ %	4½ %	4½ %	107½—109½	107½—109½	..	..	..	4 2 2
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	..	16 — 16 3/4	16 1/4 — 17	16 1/2	..	+ 1/4	5 17 8
37,500	†Liverpool Overhead Railway, Ord.	10	1/2 %	Nil	Nil	1 1/2 %	2 3/8 — 2 1/16	2 3/8 — 2 1/16	..	..	..	5 9 1
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	8 1/4 — 8 1/2	8 1/4 — 8 1/2	..	..	..	5 17 8
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	Nil	Nil	Nil	1 1/4 — 2 1/4	1 1/4 — 2 1/4	..	..	..	Nil
399,930	Do. do. 60,008 to 100,000	10	3 %	Nil	Nil	Nil	1 1/4 — 2 1/4	1 1/4 — 2 1/4	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	3 3/4 %	Nil	Nil	2 3/4 — 3 1/4	2 3/4 — 3 1/4	60/-	..	..	..
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 75	74 — 77	75	73 1/2	+ 2	5 3 11
5,722,062	Metropolitan Consolidated	100	1 %	1 %	1 %	1 1/4 %	55 — 55 1/2	54 1/2 — 55	55 1/2	54 1/2	— 1/2	2 0 11
2,640,914	Do. Surplus Lands	100	2 3/4 %	2 3/4 %	2 3/4 %	2 3/4 %	66 — 68	66 — 68	67 3/4	..	..	4 0 11
3,285,000	Do. District	100	Nil	Nil	Nil	Nil	32 — 32 1/2	32 — 32 1/2	32 1/2	31 3/4	..	Nil
891,327	Metropolitan Electric Trams., Ord.	1	..	4 1/4 %	5 %	5 1/4 %	7/8 — 1	7/8 — 1	..	..	..	5 10 0
314,016	Do. do. Defd.	1	Nil	Nil	Nil	Nil	3/16 — 7/32	3/16 — 7/32	..	..	..	Nil
600,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/4 — 5/16	1/4 — 5/16	18/-	17/6	..	5 9 7
599,183	Do. do. 4½ % Deb. Stock Red.	100	4½ %	4½ %	4½ %	4½ %	102½—104½	102½—104½	103	..	..	4 6 2
$10,828,200	Mexico Trams Co., Common Stock	..	..	..	6 %	..	126½—127½	127 —128	..	..	+ 1/2	4 18 9
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	5 %	5 %	..	96 — 97	96 — 97	97½	96½	..	5 8 1
245,000	Potteries Electric Traction	1	4 %	Nil	2 %	..	5/16 — 7/16	3/8 — 7/16	..	..	+ 1/32	4 16 11
245,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	1/2 — 5/8	1/2 — 5/8	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	85 — 88	87 — 90	..	..	+ 2	4 19 5
37,350	Telegraph Construction and Maintenance	12	17½ %	15 %	17½ %	20 %	35½ — 37½	36 — 38	37	36½	+ 1/2	6 7 0
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1919	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 5 0
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	5 %	5 %	..	102 —103	102 —103	..	..	..	4 17 1
2,818,700	Do. do. 4½ % Bonds	..	..	4½ %	4½ %	..	98 —100	98 —100	99	..	..	4 10 0
4,923,050	Do. do. 6 % Income Bonds	..	..	..	..	1 %	58 — 60	56 — 58	58 7/8	56 3/4	—1	1 14 6
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	10 %	5 %	Nil	Nil	3/16 — 1/4	3/16 — 1/4	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	6 %	3 %	Nil	1 — 1 1/8	1 — 1 1/8	..	..	..	..
215,769	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 80,449	5	10 %	10 %	10 %	10 %	7 1/8 — 7 5/8	7 1/8 — 7 5/8	..	..	..	6 12 3
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 5/8 — 7 7/8	7 5/8 — 7 7/8	..	..	..	4 11 10
402,000	Central Electric Supply 4 % Gnar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —103	99 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	4 — 4 1/2	4 — 4 1/2	..	..	..	5 11 10
80,000	Do. do. 4½ % Cum. Pref.	5	4½ %	4½ %	4½ %	4½ %	4 1/2 — 4 3/4	4 1/2 — 4 3/4	..	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½ %	4½ %	4½ %	4½ %	3 3/4 — 4 1/8	3 3/4 — 4 1/8	..	..	..	5 2 10
442,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 97	96 — 98	97 1/2	..	+ 1	4 1 8
42,436	Chelsea Electricity Supply, Ord.	5	4½ %	4½ %	4½ %	5 %	4 — 4 1/2	4 — 4 1/2	..	..	..	5 11 1
176,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	4½ %	100 —102	100 —102	..	..	..	4 8 3
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	7 %	7 %	11 1/2 — 12 1/4	11 1/2 — 12	12	..	— 1/4	5 16 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 1/4 — 12 1/4	12 — 13	12 1/2	12 1/4	+ 1/4	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	119 —123	119 —123	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½ %	4½ %	4½ %	4½ %	101 —104	101 —104	..	..	..	4 6 7
50,000	County of Durham Electrical Power, Ord.	5	2 %	Nil	Nil	..	1 3/8 — 2	1 3/8 — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	2 3/8 — 3 1/8	2 3/8 — 3 1/8	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	5 %	5 %	5 %	92 — 94	92 — 94	..	..	..	5 6 5
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7 3/8 — 8 1/8	7 3/8 — 8 1/8	..	..	..	6 3 1
55,060	Do. do. 6 % Pref., 40,001—80,000 and 120,001—135,000	10	6 %	6 %	6 %	6 %	10 3/4 — 11 1/4	10 3/4 — 11 1/4	..	..	..	5 6 8
450,000	Do. do. 4½ % Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	108½—111½	108½—111½	..	..	..	4 0 9
450,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	101 —104	101 —104	..	..	..	4 6 7
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	3/16 — 3/8	3/16 — 3/8	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	Nil	Nil	Nil	..	2 3/8 — 3 1/4	2 3/8 — 3 1/4	61/3	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	84 — 87	84 — 87	..	..	..	5 3 6
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	5 %	5 %	..	81½ — 83½	81½ — 83½	82½	82½	..	5 17 0
10,000	Folkestone, 1 to 10,000	5	5%	5%	5%	6 %	4 1/2 — 4 3/4	4 1/2 — 4 3/4	..	..	..	5 15 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4 1/2 — 5	4 1/2 — 5	..	..	..	4 11 11
94,350	Do. 4½ % 1st Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	97 —100	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	8½ %	8½ %	8½ %	9 %	6 3/8 — 7 1/8	6 3/8 — 7 1/8	..	..	..	5 19 4
$1,525,500	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	5 %	5 %	..	102 —104	102 —104	..	..	..	4 16 2
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	8 %	8 %	9 %	7 — 7 1/2	7 — 7 1/2	..	..	..	5 16 2
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
111,000	London Electric Supply Corporation, Limited, Ord.	3	2½ %	3 %	2 %	2 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	3 3 6
90,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4 1/2 — 5 1/8	4 1/2 — 5 1/8	..	..	..	5 17 1
387,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	91 — 94	91 — 94	..	..	..	4 5 1
200,000	Metropolitan Electric Supply, 100,001 to 300,000	5	6 %	5 %	5 %	5 %	3 1/2 — 4 1/16	3 1/2 — 4 1/8	..	..	..	5 12 8
76,121	Do. 4½ % Cum. Pref. 1—76,121	5	4½ %	4½ %	4½ %	4½ %	4 — 4 1/8	4 — 4 1/8	..	..	..	4 17 4
250,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½ %	4½ %	4½ %	4½ %	101 —104	101 —104	..	..	..	4 6 7
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½ %	3½ %	3½ %	3½ %	86 — 89	86 — 89	..	..	..	3 18 8
$5,929,600	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	90 — 91	90 — 91	90½	90	..	5 9 11
$18,585,000	Do. Light and Power Co., Ltd., Common	$100	4 %	3½ %	4 %	..	87 — 89	88 — 90	89½	88½	+1	4 8 11
$5,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	7 %	7 %	..	108 —111	110 —112	111⅜	110⅜	+1	6 5 0
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	5 %	5 %	5 %	95½ — 96½	95 — 96	96	95½	— 1/2	5 4 2
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½ %	4½ %	4½ %	4½ %	97 — 99	97 — 99	..	..	..	4 10 11
180,491	Newcastle-on-Tyne, 1 to 50,000 & 57,010 to 137,500	5	8 %	2½ %	4 %	4 %	4 1/8 — 4 3/8	4 — 4 1/4	..	..	— 1/8	4 8 11
137,500	Do. 5% Pref., 1 to 137,500 Non. Cum.	5	5 %	5 %	5 %	5 %	4 3/8 — 4 5/8	4 3/8 — 4 5/8	90/7 1/2	89/4 1/2	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	5 %	..	97 1/2 — 99 1/2	97 1/2 — 99 1/2	..	..	..	5 0 0
16,852	Notting Hill Electric Lighting	10	7 1/2 %	7 %	7 1/2 %	8 %	12 — 12 3/4	12 — 12 3/4	..	..	..	6 5 6
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 ..	7 %	..	6 — 6 1/4	6 — 6 1/4	..	..	..	5 7 8
120,000	River Plate Elcty. Co. Ord.	Stock	6 %	8 %	9 %	..	225 —235	225—235	..	..	..	3 16 6
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	..	108 —118	103—113	..	..	..	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102 —104	102—104	..	..	..	4 16 3
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10%	8 1/4 — 9	8 1/4 — 9	..	..	..	5 11 1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6 3/4 — 7 1/4	6 3/4 — 7 1/4	..	..	..	4 16 7
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½ %	3½ %	3½ %	3½ %	86 — 88	86 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	Nil	1 1/2 — 1 7/8	1 1/2 — 1 7/8	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	4 %	5 %	5 %	5 %	2 1/16 — 3 3/16	2 1/16 — 3 3/16	..	..	..	6 7 0
100,000	Do. do. 5 % 1st Mort. Deb.	100	..	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 3
130,000	South Met. Elec. Lt. & Power, Ord.	1	2½ %	2½ %	Nil	Nil	3/8 — 1/2	3/8 — 1/2	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	5 17 11
240,000	Do. do. 4½ % 1st Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	95 — 98	95 — 98	..	..	..	4 11 10
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	1/2 — 5/8	1/2 — 5/8	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1 3/4 — 2 1/8	1 3/4 — 2 1/8	46/3	..	..	10 10 6
271,700	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½ %	4½ %	4½ %	4½ %	85 — 87	85 — 87	..	..	..	5 3 6
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	5 %	..	..	15/16 — 1	31/32 — 1 1/32	..	..	+ 1/32	4 17 7
110,000	Westminster Electric Supply, Ord.	5	10 %	10 %	10 %	10%	7 3/4 — 8 1/4	7 3/4 — 8 1/4	7 13/32	7 31/32	..	5 19 5
81,279	Do. do. 4½ % Cum. Pref. (Reduced from 5%, since 31st Dec., 1905)	5	4½ %	4½ %	4½ %	4½ %	5 — 5 1/8	5 — 5 1/8	5 3/32	..	..	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 3 per cent. March 9th. 1911

THE ADVANTAGES OF PUBLICITY WORK.

There are certain old-fashioned proverbs which the experimental genius of mankind and the gradual accumulation of its experience are relegating to the background occupied by mythical monsters. Such quotations are of the following type:—"Good wine needs no bush," "Still waters run deep." This process of enlightenment has proceeded among all sections of the community with considerable vigour since business methods were subjected to careful analysis. It has been experimentally found that firms who were not content with merely manufacturing a good article at a fair price in accordance with the policy of their forefathers, but also insisted on telling everybody that they had good merchandise, reaped considerable advantage from this aggressive movement, and the result to-day is that the art of publicity has become an integral part of the business management of almost every industry under the sun. Until recently, at any rate in Great Britain, the electricity supply industry was a notable exception to this rule. For reasons which are difficult to enumerate, but amongst which may be placed professional prejudice and fine old English conservatism, publicity was tabooed, and it was not until the example of our American cousins, combined with the pushing tactics of our gas competitors, induced us to realise that we were not the only persons on earth, that some consideration was given to the question of advertising electricity for lighting, heating and power purposes. The movement has, however, now been successfully inaugurated, and already certain supply authorities have reaped benefits which are not merely problematical. These benefits, which form the case for the further development of publicity methods among electricity supply authorities, may be recited as follows:—

The first advantage that accrued to electricity supply undertakings who adopted publicity methods, was that these methods exerted an internal stimulating effect upon the organisation. The effort to tell outsiders what could be done with electricity crystallised the ideas of electricity supply officials. Until publicity methods were adopted the engineers in charge of supply systems were to a large extent content with concentrating their energy on the improvement of the machinery for producing electricity and of the distributing network, and were to a very great extent occupied with questions of capital and revenue, costs, efficiency of plant worked out to many decimal places, and ingenious novelties in the construction of apparatus. The commercial element did not seem to exist very strongly in their imagination. In many cases the consumer was treated more as a necessary evil than as a dispensation of Providence. When, however, it was realised that only by meeting the wishes of the consumer was the prosperity of the undertaking to be maintained, it became necessary to schedule the commercial advantages of electricity, to specify the rates at which it could be profitably supplied for different commercial purposes, and to develop new openings for the consumption of electricity. This involved quite a new point of view, and it has taken some time for supply authorities to realise that the most useful man on their staff is the one who can bring business of a lucrative and diverse character, as compared with the man whose chief function is to see that the machinery runs smoothly.

The next advantage that has been demonstrated as the result of publicity campaigns is that unsuspected wants of the public have been brought to light. Not only the supply authorities but also the manufacturers of electrical apparatus have benefited by this new idea. A simple illustration will be sufficient. In 1906-7 the great cry with regard to the use of electric heating appliances was that the apparatus could not be obtained in England, that it was necessary in order to avoid experimental goods to go either to the Continent or to America. It is not our intention to state whether or not this point of view was correct; it is sufficient to mention that it was raised. In 1908 it was no longer possible to put forward this objection, inasmuch as electrical manufacturers, stimulated by the demand which they had hitherto been unable to meet efficiently, had developed a new line in British manfacture, and were then asking themselves whether the demand would justify the amount of preliminary plant which they had laid down and initial expense which they had incurred. The point to note is that if publicity methods had not been adopted by central-station authorities the public would have had no conception that electricity suppliers could undertake heating work for them, would have made no inquiries for heating apparatus, and a distinct sphere of usefulness for electricity would then have been kept in abeyance.

Other examples could be quoted such as the spread of electro-therapeutic apparatus among doctors, and this incidentally opens up a new function of publicity work. It will be granted by most station engineers that the amount of load obtained from electro-medical appliances is inconsiderable when regarded as a direct source of revenue, but the man in charge of publicity work speedily realises the the advantage of having, in the consulting rooms of the best doctors of every town, a range of electrical apparatus. The impression left on the visitors is that electricity is clean, sanitary, adopted by doctors, and, therefore, the right thing to put in their own homes, and the indirect effect of this advertising campaign cannot be estimated. The arrival of publicity in the electricity undertakings of Great Britain has induced quite a new mode of thought with regard to the wants of the public, which is being reflected in increasing consumption.

The third advantage which has been gained by the use of publicity is that it has brought electricity supply on to a business basis. This point has been lightly touched upon before, but it needs a considerable amount of emphasising. It does not seem so very long ago since the great discussion between the adherents of the Wright demand system and the flat rate system agitated the electrical world. Compare this simple division with the numberless special rate systems adapted to particular cases which are now in vogue. Almost every engineer in charge of an electrical system has now attempted to secure a particular class of customer by means of a special rate or other inducement. The change in his attitude from that of a few years ago is tremendous. Free wiring systems, hire and hire-purchase systems, slot-meter prepayment schemes, the wiring of tenement or cottage property on special terms, the proportional charges for all day and off-peak motor loads, are all evidences of the same movement of thought among central station engineers, tending to make the system commercially more appealing to the bulk of the townspeople; and all this movement can be traced to the influence of the publicity agitation on the central station engineer.

The fourth and most important benefit which has been raised by means of the introduction of publicity is the promotion of public discussion. Electricity has nothing to fear from controversy provided that its technical exponents are well posted. Its natural qualities of healthiness, cleanliness, artistic adaptability, ease of introduction and variety of application, render it a very strong competitor for the favours of the public. Everything, therefore, which can be done to induce the non-technical public to talk about electricity is a point in favour of electricity supply. The appeal may be made through the newspapers, by means of pamphlets, by enamelled plates, by canvassing, or by any other dignified means. The effect is the same; the public is induced to talk about electricity, and the effect of talking about electricity is an increase in the sales. The possibilities of inducing the public itself to do the canvassing for electricity supply are so enormous that this point should be repeated again and again until every station engineer has grasped the meaning of it. The canvasser whom he sends out primarily to secure orders, is in reality a species of missionary, who will by the time he makes converts have established centres of information and opinion which will have their effect on large circles of possible consumers. The action of publicity is, therefore, cumulative, and provided the right lines are adopted both in the advocacy of electricity on its own merits, and the proper competitive tactics against rival forms of power and illumination, the force of publicity is one which in course of time will develop into a stronger and stronger possibility. It is no mere passing phase, provided that the initial methods adopted are right. These methods may change from time to time, but the underlying principle is correct.

REVIEWS.

The Foundations of Alternate-Current Theory. By C. V. Drysdale, D.Sc., M.I.E.E. London: Edward Arnold, 1910. Price 8s. 6d. net.

The volume under review is a *résumé* of the theoretical portion of a course on alternating-current working which the author has given for the past five years at the Northampton Institute. The chief aim in these lectures was to eliminate mathematical work as far as possible and to substitute for it mechanical analogies; in fact, the purpose of the whole work is to build up a logical theory upon purely mechanical principles. This is the first time such a thing has been attempted, at any rate on anything like so large a scale. The consequence is that we have before us a book of great originality, which presents an old and difficult subject in a new and interesting form.

This mechanical method of treating the subject lends itself naturally to practical laboratory work, and much of it can be done with very simple apparatus; in fact, it is surprising what recondite problems in the theory of the alternating current can be freely depicted visually with the aid of such ordinary apparatus as one finds in nearly every mechanical laboratory.

The author, though naturally favourably inclined towards the mechanical method of treatment of his various problems, is by no means a fanatic on the subject, for he does not advocate the disuse of mathematics altogether; as a matter of fact, he considers that mathematical treatment should follow as a natural corollary, and that, indeed, mathematical handling of abstruse questions in the theory of the alternating current is advantageous and necessary; but he also believes that such a book as he presents, which visualises to the ordinary practical man the various difficult and abstruse reactions of this department of electricity, should come *before* any serious mathematical study; for, when a student understands by mechanical analogy the nature of the problem, he will naturally be in a better position to study and express its fluctuations by mathematical symbols.

We have said that the work under review is original. In fact, it is more than original, it is highly original. We have never seen the difficult subject of alternating current presented in a more attractive form. We speak, of course, for the practical man and for the student. But, like all good things, the work has limitations, or, to speak more correctly, one limitation, and it is this: the man who takes it up must have a very good knowledge of mechanics to begin with. Nothing less will suffice. His knowledge must be very good. But granted that, he has the door opened to him for the study of the subject, in a way that it has never been opened before.

The first chapter deals with continuous currents. Analogies are presented of water and electric currents. The E.M.F. is represented by means of a pump in a pipe system carrying water. Fig. 6 shows a mechanical model of a circuit having resistance. A light truck running on rails is attached to a cord, which leads over freely-running pulleys in a framework, and weights can be attached to pull the truck along. The resistance can be varied by adding a large sail or a paddle moving in a water trough and fixed to the truck. Chapter II is on intermittent motion, inertia and resistance. There is an interesting photograph showing the rise of current in a field coil, and a mechanical model showing acceleration of mass; this leads to the explanation of electric inertia, of which the usual electrical diagrams are given. Chapter III contrasts elasticity and capacity, and the mechanical model above referred to has suitable modifications made to it to indicate practically an electric circuit with capacity. Chapter IV is on consequences of the electrical and mechanical comparisons, and upon energy and power. Plate 1 shows three different electric circuits, with analogies in the form of a liquid circuit, a moving body and a rotating body. The last two are a small model truck variously arranged, and a windmill type of revolving apparatus, respectively. Chapter V is on "Combinations of Friction, Inertia and Elasticity, or of Resistance, Inductance and Capacity," the very heading indicating the nature of the analogies used. It is strange in such a book to find such a problem worked out as the graphical construction of a velocity curve; it seems so usual to encounter that sort of problem only in the regulation text-book of mechanics. An ordinary spring with weight attached and scale is made use of to indicate inertia and to explain by analogy electric inertia, while curves are obtained from a spring model to illustrate small and large inertia; finally, these curves are contrasted with an oscillogram of condenser discharging, with low and high resistance respectively. There is then given a mechanical model of a circuit, with capacity, resistance and inductance all forming part of it.

Part II, Chapter VI, deals with simple harmonic motion. The usual engineering skeleton models, tuning forks, pendulums, &c., are made use of for illustrative purposes. Chapter VII deals with the same subject in a more advanced way, while Chapter VIII is on "The Composition and Resolution of Simple Harmonic Motions."

Part III, Chapter IX, commences with alternating currents properly, and there are many mechanical models illustrated, such as the motions of a fan, a spring, a mass (in the form of a dumb-bell held in the hand).

Chapter X is on combinations of resistance, inductance and capacity in series, and Chapter XI deals with the same in parallel, the latter being contrasted with a spring and weight in parallel, and liquid circuits in parallel. Chapter XII deals with power in A.C. circuits. Chapter XIII is on symbolic methods of vector and alternating-current calculation. This chapter will well repay study even by the man who knows a lot about the subject.

Part IV, Chapter XIV, has to do with mutual induction. Mechanical models are hereabouts freely used, including an interesting one to illustrate mutually inductive circuits. Chapter XV is on electrical oscillations, and an interesting photograph here is the hair of a violin bow under the microscope. Chapter XVI deals with simple harmonic motions in different directions and polyphase currents. The highly original use is made of the motion of a tool in the slide rest of a lathe, for illustration. The Brotherhood three-cylinder engine is also given. Chapter XVI is the recapitulation and conclusion. There is a set of exercises at the end of the book.

The whole work is very good, very original, and well worthy of a place in the library of every electrical engineer. It is also the best kind of electrical book that a mechanical engineer could have.

Dictionary of Electrical Engineering. Edited by H. M. Hobart, M.Inst.C.E. London: Gresham Publishing Co. Price 35s. net.

The compilation of a comprehensive dictionary of electrical engineering is a task considerably more difficult than the construction of an ordinary treatise on any particular branch. Whereas, in the latter case, the worker is confronted by the changes and alterations affecting his own speciality only, in the former he must be on the alert to mark the improvements effected throughout the whole extent of the science, and must be prepared for infinite and wearying change and rearrangement of the work already set up. It is, *par excellence*, the modern problem of how to effect the maximum of work in the minimum of time. In addition to this arises the necessity of compressing an account of intricate machinery or instruments into a small space, while retaining the important particulars, and setting forth the matter in a clear and easily comprehensible style. In this respect Mr. Hobart's work is worthy of every commendation, as one is at once struck as much by the directness and economy of the descriptions as by the commendable absence of those Greek signs and symbols by which so many degrees of ignorance are commonly protected from too close inspection.

The book is one which will naturally have more of a wide popular than a limited scientific use. The temptation to which every student is liable to preserve innumerable cuttings from technical journals, ending invariably in confusion, is obviated by a comprehensive compilation of this nature. The writer to the daily papers, whose ignorance of things electrical approaches the incredible, would render his contributions more serious by reference to such a work. It

might well find a place in the correspondence and commercial departments of business houses, where those who have devoted their attention more specially to the clerical side of business must often come across phrases and references which they cannot understand, but which would at once be made clear by "looking them up in the dictionary." As an instance of the clear and succinct manner in which an extensive subject is treated, may be quoted the summary of surface-contact systems of electric traction on page 515. The summing up, "Notable success has not been achieved with any surface-contact system of electric traction" is one which, had the information been accessible to municipal councillors generally, might have been the means of saving considerable sums to their boroughs. Such articles as that on rectifiers, and that on line insulators also, can hardly be improved upon.

It is unavoidable that, in some cases, the references should be hardly as direct as could be desired. For instance, the illustration of a remote-controlled oil switch depicts it as being operated by a hand lever, whereas one would have expected motor or solenoid operation to be the more emphasised, and the emergency lever to have been shown as secondary. Again, in some cases, matter is indexed under the adjective instead of the noun, a defect common to all works of the kind. It is, however, rarer in these volumes than in most, and the general arrangement is a marked advance on the so-called "pocket-book," where the compactness of the record is almost invariably nullified by bad arrangement and appallingly poor indexing.

The short articles relating to cables are especially clear and instructive, and space is found to explain what is meant by "Association Cable," a term not necessarily understood by the non-technical customer.

In this connection it may be pointed out that, wherever the subject requires it, one or two columns are devoted to the dissertation, but that in no case does this deteriorate into "talking round" the matter, the least possible space being devoted to the information necessary. In fact, the majority of the longer articles are examples of judicious "boiling down."

Naturally it is impossible to include in a work of this kind all the uses to which electricity is put in modern life. It appears rather a pity, however, that in the mention of so important a subject as radiography space was not devoted to a description and diagram of the apparatus employed, instead of leaving the inquirer to look under "Induction coil," "Condenser," "Crookes Tube," "Interrupter," &c. The same remark applies to tramway traction (slot system), where it is necessary to follow the details through the book, a process rather difficult to those imperfectly acquainted with the requirements of the equipment. There does not appear to be any reference to the large field of use opened to electricity in the manufacture of electrolytic disinfectants—such as hypochlorite of sodium or magnesium. This is the more surprising, as electrolytic bleach is included and described. There is also no mention of the type of primary cell in which the electrolyte is renewed by way of recharging.

As a work of reference useful to the student, the town councillor, architect, or civil engineer whose work has temporarily included electrical machinery, of which he has previously had no experience, as also to the writer of articles and anyone connected in a clerical or financial sense with electrical work, it will be difficult to find anything more suited to solve any difficulty arising out of unfamiliar nomenclature. The illustrations are excellent in execution, and very numerous, as is requisite in this class of work. Omission to illustrate, where illustration can render more plain, is a stupidity worthy only of the educational systems of the last century.

The Development of the Telephone in Europe. By Herbert Laws Webb, M.I.E.E. London: Electrical Press. Price 1s.

This book deals with a matter of great national importance and current interest in view of the impending changes in our telephone administration. The author's experience covers 20 years of European and American telephone development, and the special nature of his work in this direction entitles his opinions to the closest attention. His long connection with the Bell Telephone Co. of America, however, has probably biased him in favour of private (as opposed to State) management of telephone systems. Indeed, it may at once be stated that the book had better have been entitled "State Control and Telephone Development in Europe," and even then it is necessary to add that the author deals solely with the adverse effects of State management and gives no single word of praise, or even toleration, to the latter. The defects and limitations of Government control of telephone systems form the central topic throughout, and the book considers the lack of development rather than the actual growth of European telephony; it is essentially a dissertation on the stunted development caused by State interference.

No doubt Government control has greatly impeded telephone development, to how great an extent the layman may not realise till he reads this book, but we cannot but regard Mr. Webb's indictments as too severe. The admitted limitations of a State Department in the conduct of a commercial enterprise—and they are many—are clearly set forth, and the influence of the more daring and decisive policy possible in company concerns is well explained. Advertisement, canvassing and general extension of business are more strenuously practised by companies, capital flows more freely, definite persons are responsible for financially successful results and the shareholders regard profit making as essential. The sentiment repeatedly expressed is that in State Departments "Political considerations are placed before commercial and technical efficiency," and that "No department subject to political control can conduct a technical business on commercial lines." Doubtless this is to a large extent true, but we cannot agree with Mr. Webb's views regarding subordinate State employés. On p. 45 he says that "high efficiency cannot be expected of the mass of Government employés, owing to the permanence of their employment." This is flagrantly contrary to our experience. A certain massive inertia and lack of enterprise, as commercially understood, is apparently unavoidable in Government Departments, but not necessarily a low individual efficiency; indeed, rather the reverse.

A consistent attack on every Government action in connection with telephones is hardly just, particularly in view of the fact that the policy of the earlier European telephone companies was admittedly lax and lethargical. Many of the State restrictions embodied in the licences granted to telephone companies have been onerous, but a considerable proportion not unwise. Less defensible, however, is official jealousy of the telephone as a dangerous rival to the telegraph; this attitude, fortunately assumed less frequently than in the past, is utterly mistaken. In such respects as the telephone proves practically superior to the telegraph, it should be allowed unrestricted development, and fortunately the Governments of Europe are rapidly awakening to this fact. It seems likely that in England, as is proposed in Italy, a State Telephone Department will ultimately be formed and made completely independent of the telegraphs. Such a course is highly desirable, especially as telephones have led to new methods of business and created their own *clientèle* and traffic and actually compete with telegraphs to a much less extent than was anticipated.

In the opening passages of Chapter I, Mr. Webb shows that the telephone development of America (based on the Bell system—certainly the fairest standard of comparison) is ten times that of Europe, if taken on a *population basis*. Most readers will agree that some other standard of comparison should also have been included, for the European population as a whole is, in every respect, less developed than that of the United States. In the higher European countries—England, Germany, France and Austria-Hungary—there is no reason why the telephone should not attain to as high development as it already enjoys in the States, but it is doubtful whether, in many of the lower European countries, the general public would do its share in extending the development of telephony, however free a hand were allowed to companies exploiting the latter. To our mind, it is a weakness of Mr. Webb's book that the differences in character, conditions and general development, between many European countries and America, are not given greater prominence.

Chapter II reviews the early difficulties overcome by tele-

phone undertakings and the general trend of their commercial and technical development, while in Chapter III an interesting comparison is drawn between the existing telephone development in Europe and that which would obtain were it on the same scale as that of the American Bell system. The information presented might well be placed in tabular form; it would then occupy less space, and be far more readily digested, while the addition of a column of ratios of the "Bell" to the actual development would give point to the examples.

In Chapters IV, V and VI, the history of British telephone development is well told, though exception must be taken to the statement (p. 30): "As the telegraph business of the Post Office had for many years been conducted at a loss, it might be considered that the Post Office officials would be glad to see their telegraph traffic contract rather than expand, and *so reduce the loss.*" Surely, the greater the number of messages at existing rates, the less will be the loss incurred by the telegraph system, for the total costs of administration rise far more slowly than the number of messages despatched. The troublous times of 1895—1901 afford interesting reading, and the short, weak life of municipal telephony is highly significant. The defects of separate ownerships in various parts of the country (or, still worse, in single towns) are very explicitly stated, and, bearing these in mind, it is clear that purely State control must at least avoid duplication of equipment and tend to homogeneous working. How the British telephone companies weakened their position by the surrender of the trunk lines in 1892-6 is clearly explained, and the co-operation of the N.T. Co. and the Post Office authorities in the London area is, very properly, supported. All telephone engineers will concur with Mr. Webb's remarks concerning the trouble caused in the past by wayleave and underground construction disputes.

Chapter VI is of the greatest current interest and importance. In an excellent passage, the author details the lack of forethought, in 1880, as to the position which would arise on the expiry of the telephone licences, the means by which the power of the N.T. Co. has been contested in the past, and the present legal position of the company, which compels it to accept practically whatever terms are offered. The impending transfer is not likely to be on such liberal terms as were granted to the telegraph companies in 1870, despite the much higher technical and commercial perfection of the present system. The most serious feature of the position is, however, the small "spare" capacity of our existing telephone system. A fundamental precept of efficient telephone administration is that capital should be laid out years before the apparatus it provides is fully requisite. This policy has been hindered by the unfortunate clause which specifies that the Government shall purchase the N.T. Co.'s system at its value as *working plant.* As a result, the telephone system will be heavily congested when taken over, and considerable immediate capital outlay will be required to improve matters.

The general trend of Chapter VII is to compare the desirability and influence of cheapness and efficiency of service respectively—overwhelmingly, of course, in favour of the latter. Chapter VIII deals with the importance of the financial stability of telephone systems in providing the capital continually required for fresh developments.

Chapters IX-XII are occupied by a general review of European conditions and developments which, to the British telephone engineer, should prove one of the most valuable and interesting features of the book. Doubtless, Mr. Webb's European tours of 1894 and 1899, on behalf of the American Bell Co., stood him in good stead in the difficult matter of reviewing foreign policies and progress. His criticisms of foreign States are generally more charitable than those directed against his own,

The paragraph (page 58) dealing with the relation between total traffic and tariffs should be placed in a more general section, since it applies to all countries and not to Switzerland alone.

The Swiss and Scandinavian notes are particularly good, the individual works of Dr. Wietlisbach (Switzerland) and H. Cedergren (Stockholm) being deservedly praised. It is startling to find how poorly the Belgian telephones are developed, though some such condition might be anticipated in Italy, Holland and Spain. In Italy, however, great expansions are probable in the near future. German and Austrian developments are excellently reviewed considering the limited space available. The conditions and developments in Continental countries are not treated nearly so fully as those in the United Kingdom.

We are of opinion that, to justify his sweeping and consistent attack on the State control of telephones, the author should have introduced more *concrete data,* instead of relying mainly upon general statements. For instance, a golden opportunity is thrown away in the treatment of France (pp. 63-64). Undoubtedly French telephony has suffered severely by faulty State administration, but instead of closely analysing the latter, and immeasurably strengthening his case, the author "*draws a charitable veil*" over the subject and dismisses, in 1¼ pages, what might have yielded stronger and more pertinent arguments than the American comparison on which so much is based.

Among the specific data which we should like to see included, would be:—(*a*) Figures representing the use made of telephones actually installed in various countries (*e.g.,* calls per telephone and per 1,000 population per annum). (*b*) Comparisons between the telephone equipment of various large cities in Europe and America and figures representing the distribution of telephones in the various countries concerned. (*c*) Financial results of working in various countries. (*d*) Specific information concerning the development of tariffs in different States.

Throughout the book we are supplied with evidence of the extraordinary vitality of the telephone industry, which has enabled it to overcome exceptional difficulties, internal and external, and to establish a remarkable position in modern life.

Into a small space the author has compressed an enormous mass of information, but he is obviously handicapped in many places by space limitations, and we hope that later editions will be considerably larger; so long as the standard of the present treatise is maintained, there is no fear that the reader's interest will wane. Now and then we note a clumsy sentence and, more frequently, a tendency to repetition, but the tone throughout is one of wholehearted and earnest conviction. By this sincerity and the author's experience, the book, though extremist in tone, is entitled to careful perusal by all who take more than the most casual interest in the crucial stages through which our telephone system must pass within the next 12 months.—S. M. P.

An Elementary Course of Industrial Electricity. By P. Roberjot, Professeur à l'Ecole pratique d'Industrie de Reims. Paris: H. Dunod & E. Pinat. Price 4.50 fr.

This book is designed to give students of engineering the principles underlying the application of electricity to industrial purposes. It is written in what might be called the "paragraph method"; that is to say, a few words in thick black type give the gist of what is treated in the subsequent paragraph. This method has its advantages, for not only does it keep the author strictly to the subject in hand, but it places prominently before the student the particular problem under discussion. Many line diagrams are inserted throughout the text, and these are of the simplest nature; these diagrams have here and there an amateurish look about them, but, taken all round, they are very serviceable, and amply illustrate the subjects with which they deal.

The volume is well bound in semi-flexible cardboard, a distinct advance on the usual custom obtaining in France.

The work, although of an elementary nature, is undoubtedly well written and well thought out. There is no repetition; each paragraph is complete in itself and contains its information in succinct form.

The first chapter deals with the wide subject of energy, its measurements and its various forms. The units are all given and explained, and it may here be mentioned that any English electrical engineer who is desirous of obtaining a good sound knowledge of French electrical units will find this chapter invaluable. Chapter II deals only with electrical energy, and this leads to definitions of the volt, coulomb, ampere, &c. A worked example or two is given throughout the text.

Chapter III deals with the grouping of circuits in series and in parallel, and this portion of the subject is as well treated here as we have seen it in any text-book. It is a peculiar thing, but one worthy of remark, that many writers come to grief on this part of the subject. They seem to forget that they are writing for *students*, and they overload the text with mathematics and involved diagrams which are very trying to an earnest student. We are strongly of opinion that authors who are writing for elementary students should treat this subject in a very simple uninvolved manner, should deal very little with mathematics and should leave the more complex configurations alone. Chapter IV has to do with general considerations upon the generation of electricity. Kirchhoff's laws are explained. Chapter V is on batteries and accumulators. There are a couple of pages devoted to diagrams of the standard batteries with a very short index description of the construction of each. These two pages are very pleasing because of their novelty, and the method might with advantage be utilised in some of our own text-books. Chapter VI deals with the chemical action of the current. It puts in very succinct form the electrolytic laws. Chapter VII is on magnetism and electro-magnetism. We consider this the best chapter in the book, for it treats this difficult subject in a really first-class manner from the point of view of the elementary student; it goes fairly deeply into the various problems, but instinctively ceases at the point where breakdown would occur for most students; the *method* of treatment is somewhat original, and by means of the diagrams we have the subject presented in a rather fresh light, for the science of mechanics is made use of in explaining the forces in the neighbourhood of magnets.

Chapter VIII is on voltmeters and ammeters, Chapter IX on dynamos, Chapter X on motors, and Chapter XI on lighting. Illustrations are given of the tantalum and Osram lamps. Chapter XII gives an introduction to the study of the alternating current, and the subject matter is well and simply put. Chapter XIII deals with the properties of alternating currents, Chapter XIV with alternators, Chapter XV with transformers, Chapter XVI with the revolving field, Chapter XVII with alternating-current motors, Chapter XVIII with the principle of the telephone, and Chapter XIX with electric heating. Altogether the book is well written for the elementary student, the contents have been carefully thought out, the grouping of the various subjects has been well arranged, and the mathematics have been carefully used.

PROCEEDINGS OF INSTITUTIONS.

Electricity Meters, with Notes on Meter Testing.

By H. A. Ratcliff and A. E. Moore, Associate Members.

(*Paper read before the* Institution of Electrical Engineers; *see* Electrical Review, *page* 574.)

Discussion in London.

The discussion on this paper was opened by Mr. S. H. Holden (Messrs. Chamberlain & Hookham), who expressed a hope that the authors' work would throw some light on the effect of variations in wave form on meters. The authors had not said quite enough for the mercury meter, in which the resistance did not vary. Such meters had given accurate registration over seven or eight years, and could be made without shunts in large sizes. There was only one mercury watt-hour meter on the market, and it had been approved by the Board of Trade. Several makers of tramcar meters would guarantee to keep them in working order for 20 years at a fee of 3s. 3d. per meter per annum, and this did not look as if these meters were unsatisfactory. He had been informed by Mr. Baker, of the Birmingham Corporation Tramways, that a saving of £5,000 in energy had resulted from the use of meters on his 300 cars during the past year, and this despite increased mileage run as compared with the previous 12 months.

Mr. S. W. Melsom (National Physical Laboratory) said temperature coefficient was ignored by the makers of motor meters, who would help matters if they would state the temperature at which they were standardised in the works. He showed a series of curves illustrating the variation between the results obtained when meters were tested cold and when running hot after four or five hours' use. He did not think the authors' comparison of ampere-hour mercury meters and others quite fair to the former. The main coil losses in the watt-hour meter were three times as much as in the ampere-hour meter.

Mr. Garton said it had been quite possible to obtain chemically-pure copper and mercury for the last five years. This was proved by the state of meters which had been opened up. The weight of the moving element in the dynamometer type of meter was greater than in the induction type, in the ratio 100 : 25, and this practically balanced the torque difference; the total loss was less in the induction meter, and he thought it much more efficient than the dynamometer type of meter. A much better induction meter could be turned out at slightly higher cost, if people would pay for it. A polyphase meter should be used in place of single-phase meters on each phase, as he had never found a polyphase circuit to be balanced on test. He would be very much surprised to find a mercury meter bath alter much in resistance.

Mr. L. W. Wild dealt with the question of wave form; peaked and flat-topped waves produced different effects, and a smooth flat-topped wave might have produced errors in the opposite direction to those found by the authors. In his method of testing polyphase meters—connecting the current coils in series, and the shunt coils in parallel, and then reversing the connections—he found differences of 2 or 3 per cent. and took the mean. Trouble arose from the meters being connected-up differently in use and on test.

Mr. K. Edgcumbe said meter makers found it difficult to get into close touch with users, and the paper helped in this matter. The authors only dealt with the central station, which represented the bulk of the meters, but there were others. The country house installation was a difficulty, as during the bulk of the year there would be scarcely any load, but for a week or so a very heavy load, for which the meters had to be put in. In such a case it seemed better to adjust for accuracy on low loads. He thought the authors might have adopted a simpler method of adjusting the quadrature; he used a power factor indicator himself for this work.

Mr. C. A. Baker (L.C.C.) suggested that it would be better for some stations if meter maintenance were adopted, as mentioned in the case of tramway meters. Five years was a limiting period of accuracy in meters, probably three years was an average. He endorsed the authors' criticism of the electrolytic meter, which was excellent in theory, but susceptible to slamming of doors and vibration generally; he was surprised that they had ever received Board of Trade approval. Most meters were accurate, within 1 per cent. on top loads, and he was sorry that the low load test was being dropped by the Board of Trade, as it was important to be accurate on low loads now that auto-transformers were being installed for lighting. The growing use of the ampere-hour meter indicated the necessity for pressure-testing stations, such as had been introduced in London. Amongst the many sources of errors mentioned in the paper, he found no reference to defective cylometer gears.

Mr. A. P. Trotter (Board of Trade) said the authors had not sufficiently defined the various types of meters for purposes of comparison. The use of ampere-hour meters was authorised in some provisional orders, and they had less losses than the watt-hour type. He did not think a watt-hour meter for under 3 kw. could be made. The commutator ampere-hour meter test curve shown by the authors represented a meter which would nothing like pass the Board of Trade tests, and it was for the makers to disprove it. The electrolytic meter was not so bad as was made out; he thought a small and cheap ampere-hour meter, such as was now demanded, could afford 2 or 3 volts drop on 200 volts. The authors had too high ideals; 1 per cent. of inaccuracy was too small—it could not be had at the price. He agreed as to the difficulty of obtaining accurate polyphase meters. There was 38 patterns of meters on the market which had passed the Board of Trade tests; originally they were all tested to within plus or minus 2½ per cent. error, over $\frac{1}{10}$ full load, but now small meters for under 3 amperes were allowed plus or minus 3½ per cent. error.

Mr. S. Evershed said a meter might have to stand 30 times normal current on a short circuit, and the magnets would almost always be partly or wholly demagnetised under these conditions. He confirmed the test curve shown by Mr. Melsom, and said the best commutator ampere-hour meter in a batch tested was 20 per cent. wrong on $\frac{1}{10}$ load, and the worst 90 per cent.

Mr. C. C. Paterson (National Physical Laboratory) endorsed the authors' statement that indicating wattmeters read low on lagging currents due to eddy currents in metal parts near the windings, especially when wattmeters for heavier currents were in question. It was not easy to find precision indicating wattmeters for alternating current even as low as 400 or 500 amperes, which were accurate at 0·5 power factor. He knew of more than one type of precision high-grade wattmeter whose change of accuracy between unity and 0·5 power factor exceed that usually met with in induction watt-hour meters. Fig. 1 showed the behaviour of an instrument which many people regarded as above suspicion for A.C. measurements. The diagram showed the change of error in the indications of the instrument as the power factor of the load changed from 0·5 lagging, to 0·5 leading current. The volt coil had appreciable inductance, and the wattmeter was also affected by eddy currents in the metal used in its construction. It had several volt ranges, which were varied by putting resistance in series with the volt circuit. On the 50-volt range the inductance effect predominated, and the wattmeter read high on lagging currents; as more resistance was put in series with the volt circuit, the inductance was more and more swamped, and the eddy current effect predominated, causing low indications with lagging currents. On the 500-volt range, therefore, at 0·5 power factor and 50 cycles, the instrument read 2·3 per cent. low, whilst on the 50-volt range it read 3 per cent. high under the same conditions. The authors showed conclusively that it was inadmissible to test three-phase meters on single-phase circuits; but even if they were tested on three-phase circuits, it was essential to know which element was to be connected to the leading and which to the

lagging phase of the three-phase system. In fig. 2 the two elements of an induction meter were shown connected to the three-phase network in the ordinary way. If the system was supposed to rotate in the direction of the arrow and the power factor of the whole system was unity, then it would be seen that in the left-hand element the current in the series coil lagged 30° behind that in the volt coil, while in the right-hand element it led by the same

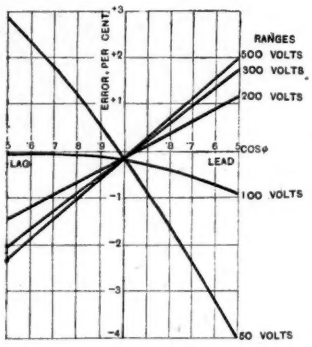


Fig. 1.—Inductance and Eddy Current Errors in Wattmeter.

amount. Each element had a separate adjustment for power factor, which compensated for loading and lagging currents, but as meters were turned out at the works, the adjustment was never exact and an element would be more or less over or under-compensated. If under-compensated, it would read low on lagging currents, and *vice versa* if over-compensated. Thus, if in fig. 2, the left-hand element was under-compensated and the right-hand over-compensated, the errors would add and the meter will read low. If the elements were interchanged the errors would again

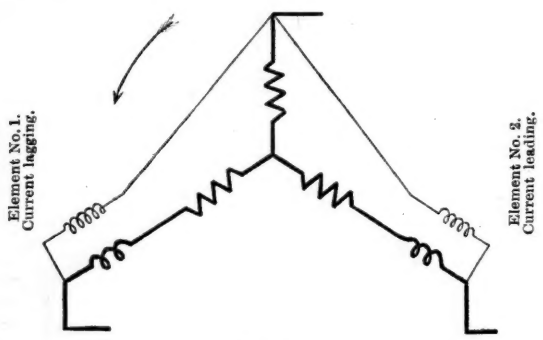


Fig. 2.

add, but, affecting the rate in the other sense, would cause the meter to register high, although in both cases the power factor of the three-phase system was unity. The upper two curves in fig. 3 illustrated two load curves of a 400-ampere three-phase meter with current transformers, tested on a three-phase circuit with phases

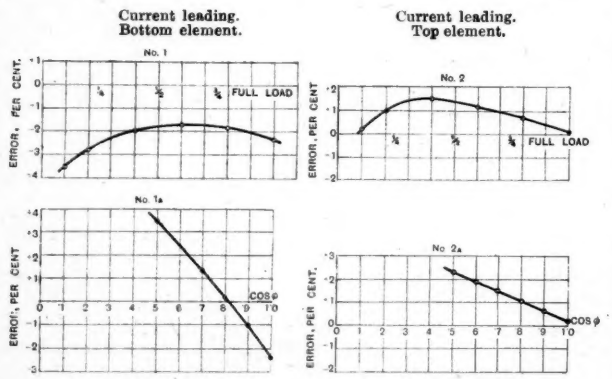


Fig. 3.

interchanged. This was not an abnormal case, and it would be seen that there was a difference of over 3 per cent. between the two ways of connecting up the elements. A further difference which existed was shown by the lower curves in which, for each method of connection, the power factor of the three-phase system had been changed. He wished to emphasise this point, because at the National Physical Laboratory they constantly had three-phase meters sent to them which had been used on dynamo and steam consumption trials, and the senders had failed to take any precaution to note which was the leading and which the lagging phase of the system to which the meter had been connected. Their method at the Laboratory was to certify the errors of the meter for both methods of connection, but the whole difficulty would be overcome if meter makers would distinctly mark on the meters which element was to be connected to which phase. If these precautions were taken and meters were tested on three-phase circuits, their experience was that the three-phase induction watt-hour meter was as reliable and accurate as any other form of integrating meter. From many tests, however, they had come to the conclusion that the single-phase test could not be taken as a guide to the performance of a meter when connected to a three-phase system, and they never certified on the single-phase test. He disagreed with the authors in their opinion that a meter ought not to be considered a three-phase meter unless it could be tested on a single-phase circuit. Why should a meter be required to comply with conditions which it would never meet with in practice, because the testing might be troublesome? The testing of three-phase meters with current transformers on three-phase circuits at all loads and power factors was a daily occurrence at Teddington, and was not attended with the inconveniences which the authors implied.

Owing to the late hour, Mr. Ratcliff replied very briefly. He suggested 12 months as the outside time limit for accuracy in a tramcar meter, and considered that a small watt-hour meter could be produced with a 1½ volt drop.

Discussion in Manchester.

Mr. G. North said that loss due to defective meters not only meant loss in generating costs, but also loss on actual standing charges—a matter which did not in general appear to receive the attention it deserved. It was far more important to have reliable meters installed than merely to save 2 or 3 watts shunt loss. The saving due to increased registration at low loads by the use of watt-hour as compared with ampere-hour meters would considerably more than compensate for the shunt loss. The cramped design of meters was almost entirely a matter of first cost. The pendulum meter was more or less perfect, in certain respects, but how often was it used as compared with other less perfect types of meters? He had had a good deal of experience with dynamometer meters on A.C., and they were absolutely no good; the vibration of the moving element was so great that the jewels and pivoted bearings wore out in a very short time, and on A.C. the bearings would not last one-quarter the time that they would on D.C. circuits, even if the jewels had spring settings. The induction meter was the nearest approach to an ideal meter and did not require anything like the attention necessary in the commutator type. As an induction motor having iron magnetic circuits and iron losses, it was sure to be affected by wave form, but the results of the authors' tests proved that a sufficient degree of accuracy was obtainable for practical conditions. He agreed with the authors as regarded polyphase meters; he never put forward balanced type meters if he could possibly help it.

Mr. H. E. Trent said that users of meters were responsible to a large extent for errors in the readings. If a meter was subjected to an abnormal temperature, the results which followed were abnormal. He cited a case in which the voltmeters had been put on top of the bus-bars; when the machines were started up, the voltmeters indicated about 600 volts, but when the load was put on, this fell to 300. In that case it was hardly fair to blame the manufacturers of the meters.

Mr. A. E. Jepson said that the black powder found in the mercury chambers of certain meters was apparently pure mercury, because if the powder was put into a very weak solution of sulphuric acid it coalesced. It was thought that it was an oxide, but that rather upset the theory. The powder might alter the resistance of the path in a shunted meter. With reference to the commutator type ampere-hour meter, if a good price was paid it was possible to get a good article. The repairs were very simple when the meters were well made. Bearings should be well made, and the jewels should be put on some form of spring. If a very wide temperature change took place in the setting, it would crack the jewel if not well set. The pitting of the pendulum arbor pivots had been remedied by the use of a stabilit absolutely free from acids. The usual temperature of 60° F. for testing meters was too high.

Mr. F. Walker said he heard of a meter the other day which had been at work eight years; it was taken out and tested, and, if anything, was better than when it was first put in.

Mr. W. Grant, speaking on the subject of ampere-hour meters, said that a consumer on a lighting circuit was supplied at a definite declared pressure, and if the pressure rose above the normal, he did not see that the supply authorities could legitimately charge for the excess units due to this rise. If the pressure rose the current increased, and the consumer paid for the excess current which he did not want, and as the lamps were overrun their life was also shortened. Commutator-type ampere-hour meters were, as the authors remarked, very flimsy. The destruction of the record with electrolytic meters was a great fault. Testing meters of this class was a very tedious business, whilst in one make the excessive voltage drop and the impossibility of reading it when the current was passing through it, due to foaming, and the artificial rising of the level militated against it. The layer of oil used on the surface did not completely stop evaporation. Crystallisation was also apt to take place with the shunted type. With regard to meters for polyphase circuits, one firm in this country recommended the use of two separate meters for this work.

Mr. R. G. Cunliffe said in Manchester they were using ampere-hour meters on tramcars with perfect success; about 20 were in use, and the results did not vary more than 5 per cent. from month to month.

Mr. W. B. Shaw, referring to the use of two single-phase meters, as compared with the combination instrument, said that there were so many advantages with the two instruments that they were well worth the extra cost. Any change in the ratio of the readings due to one of the instruments getting out of order was readily noticeable on the log sheet, and attention was therefore drawn to the faulty instrument before much error could creep into the record. With two instruments it was quite easy to obtain the average power factor over any period from the ratio of the readings, or at any moment by taking the ratio of the speeds of revolution, and using the well-known curve or formula. It would thus be a simple matter to check the wattmeters against the ammeters and voltmeters on the board, so that the accuracy of all the instruments could be watched with little trouble.

Mr. L. C. Benton said the various standardising laboratories agreed fairly well in their tests of meters of small capacities on non-inductive loads, but they were by no means in close agreement in tests on large capacity meters, especially on inductive load, which, owing to the large consumptions they registered, were the only class on which the most accurate checks were required.

Mr. W. Cramp thought there was some tendency amongst electrical engineers to strain after too much accuracy; the accuracy of electricity meters was already far in advance of anything met with in the gas world. It was clearly shown that the Aron meter was, on the whole, more accurate than most other forms and less liable to variation; it was also one of the most expensive to make, and had required an exceptional amount of skill and ingenuity in design, yet for central station work he did not think there was 10 per cent. difference in price between that meter and the ordinary motor meter. It seemed almost hopeless to expect A.C. meters to be very accurate, since not only had the phase difference and wave form to be taken into consideration, but the whole meter depended for its action upon the relationship between resistances and reactances, and it was almost impossible to calculate the latter exactly. Apart from this it seemed from the paper that wave form unless very exaggerated did not cause great errors in most meters, and the error of 27 per cent. shown in one case would never arise in practice. He wondered why manufacturers did not construct their permanent magnets of such a shape that the yoke of the magnet would shield the poles.

The Authors, in reply, said with regard to the position of meters on switchboards, the makers invariably claimed that their meters were suitable for such positions. Referring to the disintegration of mercury in meters, they agreed that there was strong support for Mr. Jepson's explanation. Experience had shown that the curves of Aron meters were not always straight lines, and it was only by making tests on several loads that faulty meters were discovered. With regard to testing temperature, 60° F. was usually recognised; testing meters at a low temperature such as 50° F. would not be practicable unless undertaken in a specially designed test room with a specially equipped staff. The two curves given for ampere-hour meters were fairly characteristic of their respective classes. Direct-current motor meters were not as a rule accurate when reversed, and A.C. motor meters would also be inaccurate under those conditions if compensated for friction in one direction only. Aron meters should be entirely satisfactory for this class of work; excellent results had been obtained with reversible battery meters of this type.

The Electrical Undertaking of the Birmingham, Tame and Rea District Board.

The following is an abstract of the reply of the author, Mr. L. F. Mountfort, to the discussion on the above-named paper, which was read before the Institution of Electrical Engineers at Birmingham, February 8th:—

The load factor referred to was the ratio of the average annual demand to the maximum demand on the station. The 0·875d. per unit included only the capital cost of the generating station and the cost of steam raising. If the cost of transmission line and substations was taken into account, the figure was approximately 1d. per unit delivered to motors. Regarding gas and electric plants, it was not his intention to imply that, for work of this kind, the costs of gas plant would, as a general rule, be less than those of electric plants. In the present instance, the circumstances were all such as to be favourable to the gas plant and unsuited for showing up the many points of superiority of electric plant. The requirements of a pumping load might range all the way between constant volume with variable head and constant head with variable volume. With constant speed, the radial vane pump was well suited to the latter requirement, and for motor-driven pumps constant-speed working was the best for all conditions. The reason why makers had not standardised the radial-vane pump was probably on the score of efficiency, as the velocity of whirl of the water on leaving the disk was very great, and if a good efficiency was desired at the pump outlet branch, a very large diffuser was required, thus adding to the cost of the pump. If this were not done, the efficiency of the pump would not generally exceed 55 per cent. The required efficiency could however, be obtained equally well by leaving out the diffuser and providing a gradually expanding delivery pipe at the pump outlet, in which the high discharge velocity head was converted into pressure head in the same manner as, and with greater efficiency of conversion than was obtained in a diffuser. The size of the pump could then be considerably reduced, and the cost of the expanding pipe was no greater than the cost of the same length of uniform pipe of greater diameter which would be required if the pump were provided with a diffuser. If the variation in volume was effected by throttling the discharge, the reduction of efficiency for a given reduction in volume was far less for radial vane pumps than for vanes with large backward curvature, although the maximum range of discharge obtainable would not be so great. The method of varying the speed of an induction motor without undue loss of efficiency, by supplying the rotor with a commutator by means of which the frequency of the rotor currents was made the same as that of the supply, would no doubt be of considerable use in cases where a variation of speed was required, but the introduction of commutating machinery certainly got very far away from the ideal simplicity of the squirrel-cage rotor. Quite apart from the question of the practicability or otherwise of efficient speed regulation, there was no doubt that with a number of pumps working together on the same load, regulation of the discharge by varying the speed of individual units was not advisable, and constant-speed working was to be preferred. There was no doubt that pressure surges were more likely to arise with squirrel-case motors and auto-transformers than with motors which were started up on non-inductive resistances, but the transformer could easily be made to withstand these momentary pressure rises, and the transmission line was generally constructed to withstand greater static disturbances than were likely to be caused by switching. The 50 per cent. tapping was the lowest tapping which it was advisable to employ in running up centrifugal pumps. With reference to the high rating of the motors, it was at first thought that the power consumption of the pumps with low heads would increase more rapidly than was afterwards found to be the case, and the condition to be guarded against was that of the head falling to the level of the surface of the filter beds. This condition might occur through the electrically-controlled sluice valves failing to shut down when taking off a pump, or through one of the pumps losing its water, either of which conditions would result in throwing a big load on the remaining pumps. As the pumps were frequently working through the night when the switchboard attendant could not see the filter beds, it was feared that this condition might last long enough to cause risk to the machine if it were to be dealt with entirely by the overload capacity of the machine. Experience has proved, however, that the motors could with safety have been rated much nearer to the pump than they had been. The figure of 157,000 units was only the power obtained from the Aston Corporation, and did not include any taken from the destructor station. The curves were taken from actual experiment, and the power curve did actually drop beyond a certain point when the head was reduced. This pump was specially designed to have this characteristic, and there was no difficulty in obtaining this effect by suitably designing the impeller. The capacity of the station was very small, and there was 100 per cent. spare plant installed. For this reason the wages and capital charges were out of all proportion to the annual output. A peak load requiring purchased energy was not of daily occurrence, and the initial cost of a battery to deal with such peaks would be prohibitive.

The Laying and Maintenance of Transmission Cables.

By C. Vernier.

(*Discussion before the* Institution of Electrical Engineers *at Newcastle, March 6th and 20th. For Abstract of paper see p.* 492.)

Mr. H. G. H. Stedman (Cleveland and Durham Electrical Power Co.) stated that a difference of potential sometimes existed between cable sheaths and rails in the vicinity, and that the polarity sometimes reversed. He had found by experiment that protective coverings on armour simply retained moisture.

Mr. Vesey Brown thought that it was against all first principles to switch in a long cable without some sort of charging device, unless, of course, the cable was specially insulated to stand this treatment. It would, however, appear to be cheaper and safer to provide simple charging gear. Those who thought that cable installation and maintenance was a simple matter were very far wrong, and, in his opinion, the cable system required more careful engineering than the power house. The South Shields system was a good example of care in cable laying, and was as good as when installed some 12 years ago.

Mr. J. M. Robb (G.P.O. Telegraphs) said that the movement of the Forth Bridge gave the P.O. engineers great trouble at first; the difficulty was got over by leaving bights in the cable. He advocated the use of machines when laying cables on the draw-in system, and said that petroleum jelly (1 cwt. per mile) was useful as a lubricant and as a precaution against electrolysis. Rats seemed to be fond of eating through lead.

Mr. C. Turnbull (Tynemouth Corporation) said that his practice was to fill joint boxes with yellow viscous compound, and he had used this successfully for 10 years, following an unfortunate experience with the black variety. Bonding cable sheaths to tram rails and water mains simply encouraged tramway currents to use the sheaths as a return path and led to claims for damages by electrolysis. He made the lead continuous throughout, and earthed at the power station only. He agreed that it was difficult to get manufacturers to supply cables with proper protection for the armouring, and mentioned cases in which unprotected armouring had disappeared completely in a very short time. Some armoured cables to his own specification were laid 12 years ago and were still in perfect condition.

Mr. F. O. Hunt suggested that the effect of surges was cumulative, and that this was the explanation of a cable breaking down on a comparatively small surge.

Mr. J. B. Johnson (P.O. Telephones) suggested that the manhole shown on diagram 2 should be moved bodily to one side, as the cables could then be run straight into the box. Manholes should

always be drained and if a sewer was not available a good substitute was a sump, consisting of a 2-ft. length of 9-in. earthenware pipe, let in flush with the bottom of the box. He also advocated caulking and sealing manhole covers in order to keep the interiors dry. His department had had great difficulties with armoured cable and now used the draw-in system exclusively, even along country roads.

Mr. W. R. Morton (W. T. Glover & Co., Ltd.) said that it was a mistake to use tape and braid covering on cables drawn into ducts, as the covering retained moisture and given the necessary conditions—wet ducts and leakage currents—the ultimate condition would probably be worse than with plain lead-covered cables. The extreme difficulty in pulling out was another objection. He remembered having broken a 37/15 jute-served cable when attempting to remove it after two years' service. Except as to price, asphalt troughing had many advantages and ran cooler than any other form of protection, except perhaps armouring laid direct. He thought that the expansive joint designed by Mr. Vernier was the only one which was both simple and effective. The high coefficient of expansion of all joint-box compounds probably accounted for leakage from these boxes, as when a cable was running warm, the compound had to escape somewhere, and on cooling down, air was drawn out of the cable cores and took the place of the compound. He thought that the Merz-Price system must be of assistance to the mains engineer in providing "clean" faults, and thus facilitating fault finding.

Mr. P. V. Hunter (Merz & McLellan) said that as 50 per cent. of the capital of a power company might be laid out in mains, nothing must be left to chance. He favoured the armoured system, as it had many advantages over the solid system, and he described the special type of protection used by the companies on the north-east coast on armoured cables. This consisted of compound, two tapes and then more compound, all over the lead. The armouring wires were then wound on and similar protective coverings applied, ordinary lime wash being applied last. It was practically impossible to remove any part of this covering, as the whole was cemented together into one solid mass. The cables on the N.E.S. Co.'s system were not specially insulated to withstand direct switching, and the absence of surges was probably due to the plant being turbine-driven exclusively. The enormous momentary pressure which cables could stand was probably accounted for by the fact that breakdowns were usually due to excessive heating of the dielectric, and an ordinary 20,000-volt cable should easily stand 100,000 volts at normal frequency for some time—*i.e.*, until the dielectric hysteresis losses raised the temperature sufficiently high to cause breakdown. Recent experience had shown that creosoted troughing was not harmful, as had been thought for years. The installation of Mr. Vernier's expansion joints on the N.E.S. Co.'s Birtley-Pelton 20,000-volt feeder had eliminated breakdowns due to earth movements. While he agreed that Trinidad bitumen was superior to pitch for cable laying, on the solid system it must not be forgotten that coal gas had a very serious effect on the former. In a similar way air had an effect on vulcanised bitumen. He had no hesitation in predicting that the use of a vacuum pump, prior to running in the soft compound, would become universal on H.T. jointing work.

Mr. E. Fawssett (N.E.S. Co.) could not see how it was possible completely and permanently to insulate lead sheaths from earth, as where there was any movement of the ground an unyielding system could not remain intact. The only safe course was to earth the lead sheath as soundly as possible. For 50° C. temperature rise on the core very high current densities might be allowed, *e.g.*, a ·0125 sq. in. three-core H.T. cable might be run up as high as 6,000 amperes per sq. in., and a ·1 sq. in. up to 1,900.

Prof. W. M. Thornton (Armstrong College) sketched a mechanical analogy showing how a cable might break down at some distance from the point at which a short-circuit had occurred and suddenly cleared. He exhibited curves in the form of loops showing the amount of energy dissipated by dielectric hysteresis, and pointed out that if the extreme point of the loop was well on the way towards the yield joint, with alternating current, it became progressive, and once this had commenced, the breakdown took place automatically.

Mr. H. W. Clothier (A. Reyrolle & Co.) said that not only were cable charging devices in use, in some places, but they were still being specified. They complicated switchgear on account of the necessary auxiliary bus-bars and interconnection, and he hoped that Mr. Vernier's paper would help to stop their use altogether. He further pointed out that a heavy short-circuit being cleared elsewhere on the system was just as likely to cause a surge on a cable as switching it in, and of course in this case the charging gear was out of action, and consequently useless. There was, however, an opening for charging gear which would keep down the current rushes which occurred on switching-in an open-circuited transformer.

Mr. T. H. Harris (A.E.G. Co.) thought that if cables were to be run at 150° F., as proposed, trouble was to be expected, as tape lost its dielectic strength at this temperature. He mentioned the case of a faulty joint out of which 35 lb. of bitumen and also the whole of the tape had completely disappeared. In another case the same thing had happened, but the pitch filling in the box surrounding the joint had taken the place of the bitumen. The joint had worked on a 20,000-volt circuit for some time in this condition. He questioned the correctness of the present-day practice of using tape alone for joints in place of tape and mica, as although the insulation resistance of a pure tape joint was higher at normal temperatures, the tape and mica joints withstood high temperatures better.

Mr. G. L. Porter (N.E.S. Co.) drew attention to the care necessary in selecting testing apparatus. He had found that a choke coil, inserted in a testing circuit to prevent a rush of current in the event of the apparatus breaking down, completely altered the shape of the wave, and in one case this effect was so pronounced that a spark gap, which normally sparked over at 9,500 volts, actually sparked at 8,000.

Mr. G. B. Addison (N.E.S. Co.) favoured the solid system, if carefully installed. Most of the troubles which had occurred with it had been due to carelessness in laying and also to using cheap materials. One great advantage was that faults were easily localised.

Mr. J. E. Dawson (Sunderland Corporation) wrote that he did not think it advisable to bond the sheaths of ordinary L.T. transmission and distribution cables. His own practice was to break the lead and armour at every joint-box, and although the system he was connected with was laid on this plan 12 years ago there had been no trouble due to electrolysis. Bonding everything up solid was simply offering a return path for leakage current, in competition with the local earth and water mains. At least one case was known where careful bonding provided such a low-resistance return that the lead sheath was fused.

Mr. J. W. Hogg wrote that he preferred the armoured system, and would lay this solid when passing through made-up ground. In order to prevent leakage of the compound along the cores, he advocated filling these with compound similar to that used in the boxes. He had had a good deal of trouble in India with the expansion of cables, and had installed expansion joints which allowed a movement of 6 in. per 110 yards on a 1 sq. in. cable.

Mr. C. Beaver (W. T. Glover & Co.) wrote asking whether the breakages which took place before the introduction of Mr. Vernier's joint, were not invariably near the joints, *i.e.*, where the cable became rigid and unable to move. He had found that looping the cables in manholes at each side of the joint box was a preventive, and in bad cases joints made with tail-end boxes connected across by loops of rubber cable and free to move on shelves or rails had been found successful. Following experiments, he had come to the conclusion that the simplest and most certain method of filling boxes with compound was to maintain a head of hot compound in a funnel feeding the box. On cables laid in chalk or limestone he had found that a bad arc sometimes resulted in the formation of calcium carbide.

Mr. C. Vernier, in reply, said that the type of braid referred to in the paper was very different from what had been used hitherto, and was of a specially strong nature. The usual proportion of oil in pitch was 1 in 7. There was not a single cable-charging device on the Newcastle Electric Supply Co. system, and although the 19-mile length of 20,000-volt cable referred to had been fitted with lightning arresters, these had never been called upon to act, so far as he knew. The use of charging gear was being abandoned by several eminent engineers. He did not think that the oil used in the construction of modern cables was liable to dry up, as it was of a particularly thick and heavy nature. Trouble similar to that experienced on the Forth Bridge had been overcome on his system by the use of the expansion joints mentioned in the paper. Trouble due to defective bonding was well deserved. It was quite within reason to expect a cable to stand an instantaneous pressure rise of 200,000 to 300,000 volts, although, of course, this pressure was never reached on a 20,000-volt system. All the advertised soldering fluxes which he had tested contained acid, and his own practice was to use pure resin or a mixture of resin and tallow, the latter being specially suitable for flexible braids. The Merz-Price system acted so instantaneously, and the faults were so clean, that it was sometimes difficult to localise them at all. He had found leakage currents from the Newcastle Tramways miles away from any part of that system. While cables should have a factor of safety of three for continuous work, they should stand surges of 10 to 20 times the normal pressure. Sparking in air took place simply because the air became ionised, and the time during which pressure was applied had a considerable effect on the sparking distance. The expense of fitting expansion joints was small when it was borne in mind that a repair on a 20,000-volt cable might cost £100 to £150. He had never know of a compression fault on an armoured cable, although he had seen tension faults. The great disadvantage of the solid system was that in the case of longitudinal ground movement the whole cable moved, whereas the armoured type did not offer the same resistance to movement of the ground. Under the usual variable weather conditions he did not see how a thoroughly sound job could be made of the solid system unless it was laid in extremely short lengths.

THE ALLEGED MONOPOLY IN THE GERMAN ELECTRICAL INDUSTRY.

The complaints made by the German Association of Electrotechnical Special Works as to the alleged monopolising of the electrical manufacturing trade and of installation work by the largest firms in that country, to which reference was made in this journal on March 24th under the title of "The Situation of the German Electrical Industry," have evoked a response on the part of one of the firms concerned. Before dealing with the reply, it is necessary to mention that the question of monopoly in both directions was recently raised in the Reichstag, and will probably again be discussed in that Parliament when the petition presented by the Association comes forward for consideration. In the meantime, the

A.E.G., which has replied in the *Frankfurter Zeitung* to the criticisms passed by the Association, considers it essential to deal separately with the interests of the special works as distinct from those of the installation contractors.

The A.E.G. points out, in the first place, that whilst the special works make serious complaints of being injured by the attitude of the large undertakings, they have just issued their report for 1910, in which they themselves most expressly disavow their grievances. For instance, the report shows that a considerable share of the total production devolves upon the special works; that their degree of activity in nearly all branches of the heavy electrical trade in 1910 was very good; that the number of workers was largely increased; that overtime was worked, and night shifts frequently; and that the turnover was from 25 to 30 per cent. higher than in 1909. The course of business proves that the large firms leave a profitable field for the special works. Indeed, the large undertakings may even claim for themselves that it is precisely their effectiveness which provides the possibility of existence for the special works, and prepares the ground for their activity. It is inherent in technical development that the preparatory pioneer work in many branches, if not in all, devolves upon the large firms, who, by the expenditure of considerable sums, open up new departments of work, and have first to provide the necessary machinery, apparatus, &c., for working them. In the ordinary course of things a portion of this activity passes over to the special firms, whilst the large firms are able and are also compelled to devote themselves again to new problems which acquire the same profitable importance for the special works. Thus there are in fact seen to exist and to prosper, specified special works in the manufacture of instruments of precision, of various electrical installation materials, heating apparatus, &c. These and similar markets they will retain in the future as hitherto. But in so far as failures were met with in the case of special works, these arose either from the incompetency of the owners, or these works had entered upon such branches of work as are only successful with bulk production, and in which the large undertakings are just as superior to the average and small firms as they are in the whole of the remaining industries. To impose fetters upon production by undertakings on a large scale would imply a fatal economic retrogression, the consequences of which would inevitably become a burden upon consumers; and to wish to suppress the special works, in whose co-operation the large firms see a welcome advancement of their own activity, is a policy which is unjustified and mistaken.

The conditions in the installation trade are next referred to by the A.E.G., which considers it necessary to go back to the origin of installations in order that the question may be comprehensible. It is mentioned that when the first electricity works were established in Germany, especially the largest in Berlin, the industry was confronted with a problem, the individual parts of which had to be solved, each by itself. One of these parts was installation work, for which trained *personnel* in general did not exist, and in which the builders of the electricity works themselves were first compelled to gain experience. The distribution of electricity to consumers was peculiar. The supply of gas and water had not presented substantial difficulties, as they were tangible to the senses directly through touch, smell, and sight. On the other hand, electricity is in no sense directly perceptible; it does not make its presence unpleasantly evident until a fault has taken place, and has already caused interruptions. The recognition of the sources of trouble, and the provision of the most suitable means of protection and safe methods of installation, occupied the electricity works a long time, and it is comprehensible that the latter, because they alone were expert, wished and were compelled to carry out the installations themselves. The knowledge that this condition could not be maintained indefinitely led to the provision of regulations for the carrying out of electrical installations, also at first through the Berlin Electricity Works; and these regulations were to the fitters of the works themselves, as well as to the staff of other contractors who had gradually devoted themselves to installation work, the firm basis for the education of the *personnel*. The experience gained in the electricity works afforded the most important guidance for the gradual improvement of installation material—experience from which all manufacturing firms without exception obtained the greatest profit. It eventually became possible to leave the establishment of installations to contractors, but the electricity works, in their own and the general interest, had to reserve the right of still exercising control over the materials and apparatus to be used. It is comprehensible that certain differences of opinion in the matter arose among the various electricity works, and the Verband-Deutscher Elektrotechniker (Union of German Electrical Engineers) therefore considered it necessary for the safety of installation work to prepare regulations for general application.

The relations between the electricity works and the installation firms, the communication proceeds to state, have gradually undergone a certain change in consequence of the development in question. After the installation branch had been brought into existence by the electricity works and the large firms, a kind of community of interests was evolved between electricity works and installation firms in the sense that the reliable contractor is regarded as representative of the efforts of the electricity works. The restrictions on the choice of installation materials have practically been dropped, and only for vital parts, over which the electricity works must keep a hand for reasons of safety, do special regulations still exist. This development, which does justice to the interests of the installation firms to the greatest extent, has taken place in connection with quite a number of works. The works which have been built by the A.E.G. and by its subsidiary companies have renounced any monopoly in installations; and works which they have acquired by purchase, and in whose agreements such privileges were embodied from the beginning, have attended to the abolition of these conditions, as the freedom of installation is the safest guarantee for the desired extension of the consumption of electricity. A certain reserve in the admission of firms of contractors is, of course, justified. It is not all persons who embark upon installation work who possess the requisite qualifications for the purpose. Unfavourable experience in this direction has induced many works to introduce restrictive regulations. The more, however, the contractors exercise a certain self-discipline in their circles, the more strictly their staff is supervised, and the better it is improved, the more readily will many of the still existing restrictions drop of their own accord.

The communication, in conclusion, submits that those who take up this standpoint in regard to the installation question cannot be reproached with aiming to supplant or exercise coercion upon the contracting class. The idea represented respecting the justification for the existence of the special works is also far distant from that of wishing to suppress these firms in favour of a monopoly for the large undertakings. If deviations from these principles come to light, the A.E.G. states that these are individual occurrences which do not give the right to accuse the large firms generally of an attitude productive of injury to the special works and installation firms in Germany.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

UNITED STATES.—In all cases where imported merchandise exceeds $100 in value, invoices must be certified by a United States Consul. All articles of foreign manufacture which are capable of being marked, stamped, branded, or labelled, without injury to the goods, must be so marked, stamped, branded, or labelled, in legible English words, in a conspicuous place, that must not be covered or obscured by any subsequent attachments or arrangements so as to indicate the country of origin; such marking, stamping, branding, or labelling, must be as nearly indelible and permanent as the nature of the article will permit.

The rates of duty leviable on electrical goods imported into the United States, in accordance with the new tariff which came into force on August 5th, 1909, were published in the Electrical Review on September 24th and October 1st, 1909.

Indian Notes.—(From our own Correspondent).—Madras.—The extension of the supply company's mains goes on rapidly, and new consumers are being added daily. The perseverance and able management of Mr. St. John, the chief engineer, have rescued what once promised to be a financial failure, and made an assured success of the undertaking. The valuable assistance given by the chief assistant, Mr. Scott Mackenzie, and also by the mains superintendent, Mr. Radford, has contributed in no small measure to the promotion of the company's interests. For some reason unknown to the public, things seem to have been badly bungled before these gentlemen came on the scene. Miles of street mains were laid before the machinery was ready, and a couple of temporary generating plants, entirely out of proportion to current demands, were put down just to keep within the letter of the Government concession by having the mains "alive" within a stipulated time. However, after a dearly-bought experience, the shareholders are within reasonable distance of fairly good returns. The tramway load has been entirely taken over by the Supply Co, at a reasonable figure. A good deal of street lighting is done, and extensions are under consideration; most of the large Government buildings are being joined up to the mains, and altogether the officials and shareholders are to be congratulated on fairly healthy prospects. At the outset of its career the Supply Co. made the fatal mistake of constituting itself both a supply and a trading company, with lofty and entire disregard to the disastrous examples of reckless trading at home and abroad. In its grasping desire to secure all available profits the company sunk a large amount of money in electric fans; these became a drug on the Madras market, and eventually had to be sold at less than cost in order to release capital uselessly invested.

Electricity in the Southern States.—In an address before the Southern Commercial Congress, Atlanta, Ga., Mr. George Westinghouse recently outlined the part being played by electricity in the development of the South. The rivers of the Appalachian Mountains can be developed for from 5,000,000 H.P. to 7,000,000 H.P. during the dry season of the year, so that hydroelectric installations are destined to assume a universal and fundamental part in the life of future generations in the South. A noteworthy beginning has been made by the Southern Power Co., which furnishes energy for lighting 45 cities and towns and for operating six street railway systems.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

7,568. "Sparking plug." J. E. Meredith. March 27th.

7,569. "Electric current detectors or apparatus for detecting the presence and direction of electric current." W. Frisby. March 27th.

7,582. "Spark generator for wireless telegraphy." E. O. Walker. March 27th.

7,611. "Telephone exchange systems." E. E. Clement. March 27th. (Complete.)

7,631. "Method of electrically braking polyphase series motors." Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany.) March 27th. (Complete.)

7,635. "Circuit-breaker more particularly for use in connection with electric tram and railway systems." P. M. Levy and H. T. George. March 27th.

7,645. "Safety interrupter for electric tramways with overhead line." G. P. de Bonaparte. March 27th.

7,668. "Electric voltage regulators." Allgemeine Elektricitats Ges. (Convention date, March 26th, 1910, Germany.) March 27th. (Complete.)

7,669. "Electric meters." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitats Ges., Germany.) March 27th.

7,671. "Electric alarm system." A. Goldstein. (Convention date, March 28th, 1910, United States.) March 27th. (Complete.)

7,675. "Electric terminals or connectors." W. W. Genn. March 27th.

7,697. "Apparatus for utilising electrically produced heat for domestic and other purposes." H. W. Purle. March 28th.

7,705. "Methods of and means for changing the frequency of alternating currents." A. M. Taylor. March 28th.

7,749. "Means applicable for use in the production of high-frequency electric currents." J. G. Balsillie. March 28th.

7,764. "Generation of electric energy and apparatus therefor." W. S. Simpson. March 28th.

7,785. "Controlling electric motors." P. C. Holmes and A. L. Holmes. March 29th.

7,787. "Sparking plugs for ignition of the combustible mixture in internal combustion engines and the like." F. H. Wallace and T. Green. March 29th.

7,789. "Sparking plugs for internal combustion engines." D. W. Player and F. W. Hill. March 29th.

7,803. "Combined lamp lock and shade-holder for incandescent electric lamps." A. C. Lauder. March 29th.

7,810. "Sparking plugs for internal combustion engines." D. W. Player and F. W. Hill. March 29th.

7,852. "Automatic or semi-automatic telephone exchange circuits." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt. Ges., Germany.) March 29th. (Complete.)

7,862. "Operation of electrical clock and like installations." H. Aron Elektricitatszahler-Fabrik G.m.b.H. (Convention date, January 7th, 1911, Germany.) March 29th. (Complete.)

7,872. "Continuous electric switch." F. M. Godshall Johnson. March 29th. (Complete.)

7,876. "Telephone systems." E. D. Fales. (Divided application on No. 1,422/10, January 19th). March 29th. (Complete.)

7,877. "Telephone systems." E. D. Fales. (Divided application on No. 1,422/10, January 19th). March 29th. (Complete.)

7,878. "Telephone systems." E. D. Fales. (Divided application on No. 1,422/10, January 19th.) March 29th. (Complete.)

7,882. "Electrically-operated automatic reversing mechanism for electrically-driven machine tools." B. E. Ellson. March 29th.

7,896. "Electric time relays." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitats Ges., Germany.) March 29th.

7,906. "Arrangement for electrically transmitting compass positions to a distance." L. Biermasz. (Convention date, March 31st, 1910, Germany.) March 29th. (Complete.)

8,004. "Incandescing bodies for electric lamps and methods of manufacturing the same." K. Schwab. (Convention date, April 9th, 1910, Germany.) March 30th. (Complete.)

8,017. "Process and apparatus for transmission to a distance by electricity of pictures, writing and the like." F. de Bernochi. (Convention date, April 1st, 1910, Italy.) March 30th. (Complete.)

8,018. "Electric flame arc lamps." F. W. F. Schuer and F. W. D. Haddrell. March 30th.

8,023. "Electric meters." J. F. Monnot. (Convention date, April 1st, 1910, France.) March 30th. (Complete.)

8,032. "Electricity meters according to the Ferraris principle." M. Strelow. (Addition to No. 21,240 of 1910. Convention date, March 30th, 1910, Germany.) March 30th. (Complete.)

8,033. "Electrical measuring instruments." M. Strelow. (Convention date, March 30th, 1910, Germany.) March 30th. (Complete.)

8,039. "Electric clocks." H. T. W. Bowell and G. B. Bowell. March 30th.

8,044. "Electric alarm signal." E. E. Rogers. March 30th.

8,062. "Dielectrics in contact-breakers." R. S. Wright and E. E. Murnside. March 31st.

8,082. "Separation of liquids by electrical treatment." E. A. C. Kochs. March 31st.

8,103. "Electric arc lamps." K. Oertel. March 31st. (Complete.)

8,109. "Auto electrically-illuminated jug." R. Fisler. March 31st.

8,149. "Control of alternating-current electric motors." E. F. W. Alexanderson. (Convention date, April 2nd, 1910, United States.) March 31st. (Complete.)

8,150. "Electric voltage regulators." Allgemeine Elektricitats Ges. (Convention date, April 1st, 1910, Germany.) March 31st. (Complete.)

8,151. "Electric motor-controlled regulating devices for furnace dampers, valves and the like." O. Rennert. (Convention date, April 1st, 1910, Germany.) March 31st. (Complete.)

8,205. "Electric switches, circuit-breakers and the like." D. K. Morris and G. A. Lister. April 1st.

8,224. "Carbon holder for distributors of electrical ignition machines." A. G. Bloxam. (R. Bosch, firm of, Germany.) April 1st. (Complete.)

8,225. "Operating railway block telegraph indicators." A. T. Blackall and C. M. Jacobs. April 1st. (Complete.)

8,236. "Wireless telegraphy." E. Bull, O. Arnesen and A. W. Sizer. April 1st.

8,238. "Controllers for electric motors." British Thomson-Houston Co., Ltd., and W. L. Wise. April 1st.

8,246. "Elbowed horn for telephone transmitters, receivers and such like instruments." F. A. Boyd. (Addition to 21,232 of 1910.) April 1st.

7,868. "Machines for making the joint between the filament support and the lamp bulb in incandescent electric lamps." J. Barrollier. (Convention date, March 29th, 1910, in France.) March 29th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

Electric Furnaces. E. Wassmer. 28,813. December 9th.

1910.

Electric Switching Device. W. Fairweather. 22,412. September 27th.

Electrical Commutator Switches. Soc. Anon. "Phi." 24,851. October 26th.

Starting and Speed Regulation of Polyphase Electric Motors. Siemens Bros. Dynamo Works. 25,964. November 8th.

Electric Rail Bonds. British Thomson-Houston Co. (General Electric Co.) 30,138. December 28th.

Electromagnetic Signalling Devices for Selectively Operating Two or more Alternate Signals or Indicators, using one line wire and earth or two wires only. J. Willis and B. Johnson. 101. January 3rd. (July 2nd, 1910.)

Protective Devices of the type known as Lightning Arresters. British Thomson-Houston Co. (General Electric Co.) 211. January 4th.

Controllers for Electric Motors. Adams Mfg. Co. (Cutler-Hammer Mfg. Co.) 5,278. March 2nd.

Incandescent Electric Lamps. J. A. Scoular, M. Scoular and E. F. Everett. 5,289. March 2nd.

Employment of Metals in the Electric Arc for Sterilising Liquids. E. Urbain, A. Feige and C. Scal. 5,393. March 3rd. (Addition to No. 4,795 of 1910.)

Electric Switches. A. E. Creese and W. Dederich. 5,465. March 4th.

Electrically Heated Appliances or Apparatus for Domestic or other purposes. C. O. Bastian. 6,207. March 12th.

Driving of Electric Rail Vehicles. Akt.-Ges. Brown, Boverie et Cie. 6,403. March 14th. (April 1st, 1909.)

Connections for Terminal Ends of Electrical Cables. R. F. Hall. 6,431. March 15th.

Dielectric Filling or Insulating Composition. R. C. Sharp. 9,983. April 23rd.

Electric Cable. C. J. Beaver, G. W. L. Preece and E. A. Claremont. 11,792. May 12th.

Incandescent Electric Lamps. A. F. F. Stodd. 11,931. May 13th.

Electric Arc Lamps. J. H. H. Jaburg. 13,305. June 1st. (June 2nd, 1909.)

Devices for Controlling the Speed of Electric Motors. Adams Mfg. Co. (Cutler-Hammer Mfg. Co.) 13,406. June 2nd.

Alloys Suitable for Use as Electric Resistance Conductors. British Thomson-Houston Co. (General Electric Co.) 14,143. June 16th.

Illuminating Devices in China.—In the course of an interesting report, American Consul Julean H. Arnold, of Amoy, refers as follows to the above subject:—

"In Yenchuan, in Northern Shensi, petroleum from native wells is refined by a Chinese company, the plant having been installed five years ago by a Japanese firm. The supply is said to be inexhaustible. The refined oil is transported over rough cart roads 200 miles to Sianfu, where it is sold in open market for the equivalent of 30 cents United States currency a gallon, competing with foreign kerosene, which sells for 43 cents a gallon. The larger cities throughout Central Shensi are being supplied with the products of the wells of Northern Shensi. The company is considering the construction of a light railway from Yenchuan to Sianfu, as transportation by cart costs them at least 5 cents United States gold per ton-mile. Throughout West China rapeseed oil serves almost universally as the only illuminant. The little taper in the vessel of rapeseed oil, with its dim flickering light, has been serving for centuries to light the way of the millions of West China. The twentieth century is witnessing the dawn of a new era in China. Already Western civilisation has illuminated the streets of Taiyuanfu, the capital of Shensi, with electricity. In Sianfu, the capital of Shensi, and in Chengtu, the capital of Szechuan, as well as in several other large cities of this latter province, patent kerosene lamps are directing the eyes of the natives toward Western civilisation. Chungking is installing an electric plant costing about $100,000. So soon as West China is tapped with modern transportation facilities, the inadequate rapeseed oil will be rapidly displaced by kerosene, electricity, and other modern illuminants."

American Consul-General George E. Anderson, of Hong-Kong, writes on the same subject as follows:—

"There is a good and growing field in China for many lines of lighting specialties, particularly gasoline and improved kerosene gas lamps. There is a good demand for such goods in the ports where the advantage of modern lighting is known and where electric light or gas light may in most cases be had. Such lights to the average Chinese shopkeeper or resident are known more by example than experience, both as a matter of cost and because of the fact that in many ports the Chinese quarter is poorly served with such lighting conveniences, if served at all. In some portions of China, notably in some parts of Kwangtung Province and Fukien Province, Chinese who have been abroad for many years and have learned to appreciate foreign things have difficulty in bringing themselves to be satisfied with the old peanut-oil lamps or even modern kerosene lamps which are used by the mass of the people. They are disposed to buy what modern lighting specialties are to be found on the market, and some of them have put in acetylene gas plants for their houses or places of business, others look for improved kerosene lamps, while almost all of them are open to almost any proposition which looks to advancement in such things."